



Biological Assessment Study

**Pearson Creek
Greene County**

2014 - 2015

Prepared for:

**Missouri Department of Natural Resources
Division of Environmental Quality
Water Protection Program
Water Pollution Control Branch**

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1.0 Introduction

At the request of the Missouri Department of Natural Resources' (MoDNR) Water Protection Program (WPP), the Environmental Services Program's (ESP) Water Quality Monitoring Section (WQMS) conducted a biological assessment of Pearson Creek in Greene County, Missouri. Pearson Creek was originally placed on the 303(d) list in 1998 for unknown toxicity for the stream segment downstream of Jones Branch (1.5 miles) and is currently on the 2014 303(d) list for 8 miles for *Escherichia coli* bacteria, aquatic macroinvertebrate bioassessments, and unknown sources. Pearson Creek is a tributary of the James River and is located in the Ozark/White Ecological Drainage Unit (EDU).

1.1 Study Area/Justification

Pearson Creek originates in eastern Greene County near the town of Strafford and flows southwest toward the city of Springfield where it discharges into the James River (Figure 1). Pearson Creek is listed in the Missouri Water Quality Standards (MoDNR 2014a) as a class "P" stream for a distance of 8.0 miles upstream from its confluence with the James River. Designated uses for Pearson Creek are "warm water aquatic life protection," "human health/fish consumption," "livestock and wildlife watering," and "class A whole body contact recreation." The northern and eastern portion of the Pearson Creek watershed consists primarily of agricultural lands, and the western and southern portions consist primarily of urban development from the city of Springfield (Figure 2). Mining operations that were part of the tri-state mining area took place in the Pearson Creek watershed from 1885 to 1920 (Thomson 1986). There were about 40 mines and prospecting locations with some of the sites near Jones Branch and Pearson Creek #1 (Figure 2).

A biological assessment study was conducted during the fall 2004 and spring 2005 sampling seasons (MoDNR 2006). One station was sampled in fall 2004 and two stations were sampled during the spring 2005 sampling season. The sampling stations were located immediately downstream of Jones Branch confluence (Station #2) and about 0.6 miles downstream of Jones Spring Branch (Station #1). The results of the study found the macroinvertebrate community was impaired at all stations during both sampling seasons compared to the Ozark/White EDU biological criteria. The study also found that a sediment sample analyzed using Microtox[®] collected in Jones Branch near its confluence with Pearson Creek during the spring 2005 sampling season had an EC20 value that indicated acute toxicity. The EC20 is the effective concentration of a sample that causes a 20 percent decrease in the light output of the bioluminescent test organism used in Microtox[®] testing. For this study, station #2 was not sampled because more samples have historically been collected at station #1 and because the two stations were located within 0.6 miles of each other.

1.2 Purpose

The purpose of the study is to reassess Pearson Creek to determine if the macroinvertebrate community is still impaired. This study assessed the macroinvertebrate community upstream and downstream of Jones Branch to determine whether the spring branch has an effect on the Pearson Creek macroinvertebrate community. Water and sediment samples were collected from Pearson Creek and Jones Branch to determine possible sources of impairment.

1.3 Objectives

- 1) Determine if the macroinvertebrate community in Pearson Creek is impaired compared to biological criteria developed from reference stream data in the Ozark/White EDU.
- 2) Determine if the water quality in Pearson Creek is impaired compared to the Missouri Water Quality Standards.
- 3) Assess the habitat quality of Pearson Creek.

1.4 Tasks

- 1) Conduct a bioassessment of the macroinvertebrate community on Pearson Creek at three sampling stations during the fall 2014 and spring 2015 sampling seasons.
- 2) Conduct a water quality assessment of the water and sediment at the Pearson Creek sampling stations and a station on Jones Branch to determine potential water quality impairment.
- 3) Conduct a habitat assessment at the sampling stations to ensure comparability of aquatic habitats.

1.5 Null Hypotheses

- 1) The macroinvertebrate community will not differ among longitudinally separate reaches of Pearson Creek.
- 2) The macroinvertebrate assemblages in the Pearson Creek samples will be similar to the Ozark/White EDU Wadeable/Perennial stream biological criteria.
- 3) Physicochemical water quality from Pearson Creek will meet the Water Quality Standards (**WQS**) of Missouri (MoDNR 2014a).
- 4) Physicochemical water quality will not differ among longitudinally separate reaches of Pearson Creek.
- 5) Sediment constituent values will be below Probable Effect Concentrations (**PEC**) as described in MacDonald et al. (2000) and MacDonald et al. (2009).

2.0 Methods

Carl Wakefield, Mike Irwin, and Raissa Espejo of the Missouri Department of Natural Resources, Division of Environmental Quality, Environmental Services Program, Water Quality Monitoring Section conducted this study.

2.1 Study Timing

Macroinvertebrate, sediment, and water samples were collected at the Pearson Creek sampling stations during the fall 2014 and spring 2015 sampling seasons. Sediment and water samples also were collected at a station on Jones Branch during the fall and spring sampling seasons;

Figure 1
Map of Pearson Creek and Sampling Stations

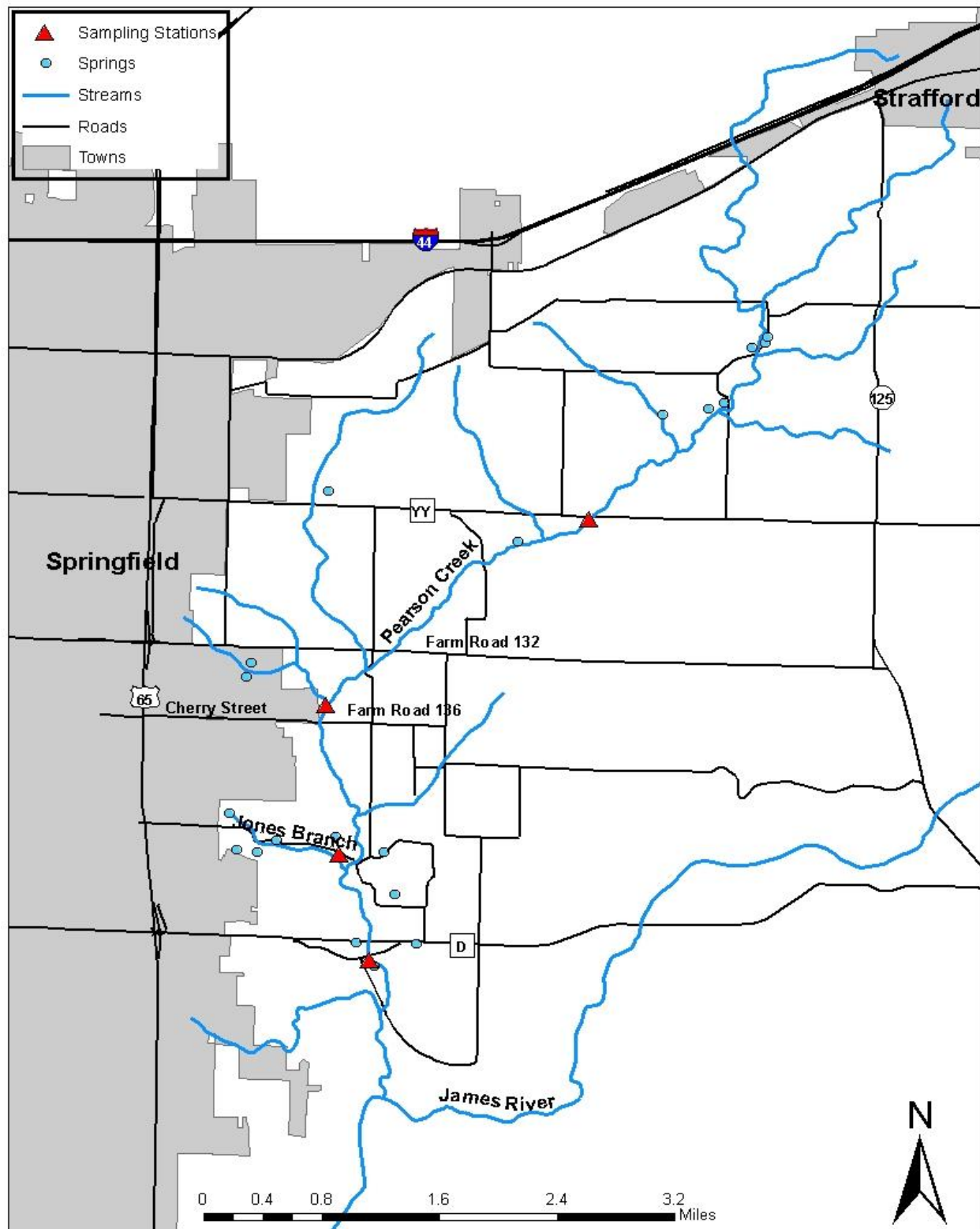
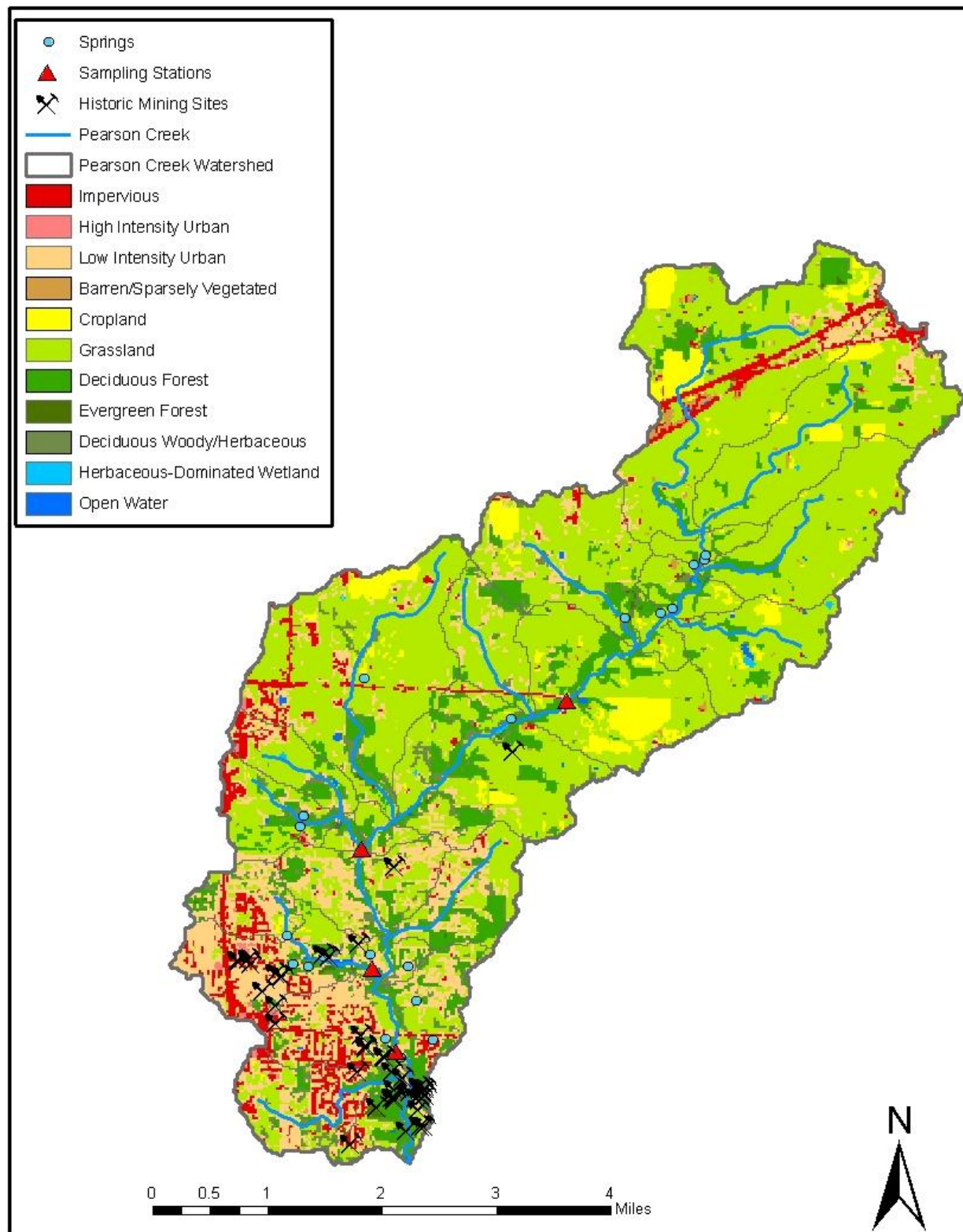


Figure 2
Land Use of the Pearson Creek Watershed



however, macroinvertebrates were not collected at this site. Fall 2014 sampling was conducted on September 23, 2014, and spring 2015 sampling was conducted on March 25, 2015.

2.2 Station Descriptions

The study area and sampling locations for the Pearson Creek biological assessment study are shown in Figures 1 and 2. A total of three Pearson Creek test stations and one station on Jones Branch were surveyed for this study.

2.2.1 Pearson Creek Biological Assessment Sampling Stations

Pearson Creek #1 – Greene County: Legal description is N 1/2, Sec. 35, T. 29 N., R. 21 W. Geographic coordinates are UTM zone 15, 482382 Easting, 4114616 Northing. The sampling station was located downstream of Farm Road 148 and United States Geological Survey (USGS) gauge station 07050690.

Pearson Creek #3 – Greene County: Legal description is NW ¼ Sec. 23, T. 29 N., R. 21 W. Geographic coordinates are UTM zone 15, 481854 Easting, 4117267 Northing. The sampling station was located upstream of Farm Road 136.

Pearson Creek #4 – Greene County: Legal description is NE ¼ Sec. 13, T. 29 N., R. 21 W. Geographic coordinates are UTM zone 15, 484833 Easting, 4119569 Northing. The sampling station was located downstream of Highway YY.

Jones Branch – Greene County: Legal description is NW ¼, Sec. 26, T. 29 N., R. 21 W. Geographic coordinates are UTM zone 15, 482079 Easting, 4115763 Northing. Samples were collected near Farm Road 144.

2.3 MoRAP Aquatic Ecological Classification

The aquatic ecological classification developed by the MoRAP is a classification system that divides the aquatic resources of Missouri into distinct regions. It has seven levels of classification starting at large regions and then dividing them into smaller sub-regions (Sowa et al. 2004). The following are the seven levels of classification in hierarchical order: zone, subzone, region, aquatic subregions, Ecological Drainage Units (EDU), Aquatic Ecological Systems (AES), and Valley Segment Types (VST). The levels of classification are based on biology, zoogeography, taxonomic composition, geology, soils, and groundwater connection. Some levels of the hierarchical system use geology and soils to classify whereas other levels use biology and taxonomic composition of aquatic communities. EDU, AES, and VST are the three levels of classification that will be assessed in detail for this study.

2.3.1 Ecological Drainage Unit

The EDU is level five of the classification hierarchy and is based on geographical variation of the taxonomic composition of the level four subregions. An EDU is a region in which aquatic biological communities and habitat conditions can be expected to be similar. Land cover percentages for the Missouri portion of the Ozark/White EDU and the Pearson Creek test stations are shown in Figure 2 and Table 1. Land cover data were derived from the MoRAP Thematic Mapper satellite data from 2000 to 2004. Compared to the entire Ozark/White EDU, land use

among Pearson Creek test stations was higher for percent grassland, cropland, impervious surface, and low intensity urban, but lower for forest. Within the Pearson Creek watershed, the lower portion had much higher impervious surface and low intensity urban land use than the upper portion.

Table 1
 Percent Land Cover from MoRAP Thematic Mapper Satellite Data from 2000 to 2004

Land Cover	Ozark/White EDU	Pearson Creek #1	Pearson Creek #3	Pearson Creek #4
Impervious	1.5	5.3	4.0	3.3
High Intensity Urban	0.2	0.3	0.1	0.02
Low Intensity Urban	1.8	14.1	6.4	4.3
Barren/Sparsely Vegetated	1.5	0.6	0.8	1.2
Cropland	1.3	5.2	6.6	8.6
Grassland	37.2	59.2	68.1	70.9
Deciduous Forest	44.5	10.8	10.1	8.9
Evergreen Forest	3.3	0.3	0.3	0.3
Mixed Forest	0.2	--	--	--
Deciduous Woody/Herbaceous	5.6	3.7	3.2	2.1
Evergreen Woody/Herbaceous	0.3	--	--	--
Herbaceous-Dominated Wetland	0.1	0.1	0.2	0.1
Open Water	2.5	0.4	0.3	0.3

2.3.2 Aquatic Ecological Systems

Aquatic Ecological Systems are level six of the classification hierarchy. They classify aquatic systems based on geology, soils, landform, and groundwater influence. Pearson Creek is located in the Finley Creek AES type (Sowa and Diamond 2006). Local relief for the Finley Creek AES type is variable and ranges from nearly zero to 200 feet. Bedrock geology is dominated by Mississippian period cherty limestones with significant karst features like sinkholes, caves, and springs. Sinkholes and losing streams are very abundant, with some of the highest densities occurring in this AES type. Surface soil textures consist of cherty and silt loams with moderate to slow infiltration rates. Streams carry bed loads consisting of sand and chert gravel with very little suspended sediment. Springs are common and can be quite large, contributing significantly to stream base flows. Groundwater and cold water are abundant and are important features.

2.3.3 Valley Segment Types

Valley Segment Types are level seven of the classification hierarchy. Stream segments in the GIS stream network layer are classified using a 5-digit code. The 5-digit VST code is based on temperature regime, stream size, flow regime, geology, and relative gradient. The 5-digit VST codes and the values for the five parameters making up the codes can be found in Table 2.

Table 2
 Physical Characteristics of the Sampling Reaches for Pearson Creek Based on Values from the MoRAP Valley Segment Types (VST) Geographic Information Systems (GIS) Layer and Other GIS Sources

	Pearson Creek #1	Pearson Creek #3	Pearson Creek #4
Watershed Area (mi ²)	21.8	17.2	10.8
Strahler Order	3	2	2
Link Magnitude	11	7	5
VST 5 Digit Code	22122	22122	22122
Temperature Regime	Warm	Warm	Warm
Stream Size	Creek	Creek	Creek
Flow Regime	Permanent	Permanent	Permanent
Geology	Limestone	Limestone	Limestone
Relative Gradient	Medium	Medium	Medium

2.4 Habitat Assessment

A standardized assessment procedure was followed as described for riffle/pool habitat in the *Stream Habitat Assessment Project Procedure (SHAPP)* (MoDNR 2010e). Habitat assessments were conducted at the three Pearson Creek test stations and the North Fork of the White River biological criteria reference station in September of 2014.

2.5 Biological Assessment

Biological assessments consisted of macroinvertebrate collection and physicochemical sampling for the two sample periods.

2.5.1 Macroinvertebrate Collection and Analysis

A standardized macroinvertebrate sample collection and analysis procedure was followed as described in the *Semi-quantitative Macroinvertebrate Stream Bioassessment Project Procedure (SMSBPP)* (MoDNR 2012a) for riffle/pool (**RP**) streams. Three standard habitats— flowing water over coarse substrate (**CS**), depositional substrate in non-flowing water (**NF**), and rootmat (**RM**)—were collected at the sampling stations.

Macroinvertebrate data were analyzed using two methods. The first analysis was to calculate the Macroinvertebrate Stream Condition Index (**MSCI**) using the four general biological metrics found in the SMSBPP (MoDNR 2002; MoDNR 2012a). These four biological metrics included: 1) Taxa Richness (**TR**); 2) Ephemeroptera/Plecoptera/Trichoptera Taxa (**EPTT**); 3) Biotic Index (**BI**); and 4) Shannon Diversity Index (**SDI**). These individual metrics were scored by comparing them to the biological criteria for perennial/wadeable streams from the Ozark/White EDU and combined to form the Macroinvertebrate Stream Condition Index (**MSCI**). MSCI scores of 16-20 qualify as fully supporting, 10-14 are partially supporting, and 4-8 are considered non-supporting of the protection of warm water aquatic life beneficial use designation as specified in the Missouri Water Quality Standards (MoDNR 2014a).

The second analysis was an evaluation of macroinvertebrate community composition using percent composition of EPTT, sensitive taxa, functional feeding groups (**FFG**), and dominant macroinvertebrate families and taxa. The macroinvertebrate community of Pearson Creek was compared to the biological criteria reference streams.

2.6 Physicochemical Data Collection and Analysis

2.6.1 *In situ* Water Quality Measurements

During each sampling period, *in situ* water quality measurements were collected at each of the bioassessment sampling stations. Field measurements included water temperature (°C) (MoDNR 2010b), dissolved oxygen (mg/L) (MoDNR 2012c), conductivity (µS/cm) (MoDNR 2010c), and pH (MoDNR 2012b).

2.6.2 Water Chemistry

Surface water grab samples were collected and returned for analyses to ESP's Water Quality Monitoring and Chemical Analysis sections. Turbidity (NTU) (MoDNR 2010a) was measured and recorded in the ESP WQMS biology laboratory. Water samples were analyzed by ESP's Chemical Analysis Section (**CAS**) for total suspended solids, chloride, sulfate, total calcium, total magnesium, total phosphorus, ammonia-N, nitrate+nitrite-N, total nitrogen, and dissolved metals. Metals constituents analyzed included arsenic, barium, cadmium, chromium, calcium, cobalt, copper, lead, manganese, mercury, nickel, selenium, thallium, and zinc. Samples for metals were filtered in the field using a 0.45 µm filter. Procedures outlined in Standard Operating Procedure (**SOP**) MDNR-ESP-001, *Required/Recommended Containers, Volumes, Preservatives, Holding Times, and Special Sampling Considerations* (MoDNR 2014b), and SOP MDNR-ESP-002, *Field Sheet and Chain-of-Custody Record* (MoDNR 2014c), were followed when collecting water quality samples. Stream velocity was measured at each station using a SonTek/YSI FlowTracker Handheld-ADV (Acoustic Doppler Velocimeter). Discharge was calculated per the methods in SOP MDNR-ESP-113, *Flow Measurement in Open Channels* (MoDNR 2013).

2.6.3 Fine Sediment

Fine sediment was characterized for total recoverable metals and Base Neutral/Acid Extractables analysis (**BNAs**). One composite sample of fine sediment was collected at each test station. The sediment samples were collected by dredging up fine sediment at multiple locations within the sample reach using a 2-ounce glass jar and compositing it into an 8-ounce glass jar. No sediment sample was collected at Pearson Creek #4 during the fall 2014 sampling season because very little fine sediment was observed at the station. Sediment samples were kept on ice and delivered to the ESP CAS in Jefferson City, Missouri, for analysis. Procedures outlined in the SOPs MDNR-ESP-001, *Required/Recommended Containers, Volumes, Preservatives, Holding Times, and Special Sampling Considerations* (MoDNR 2014b), and MDNR-ESP-002, *Field Sheet and Chain-of-Custody Record* (MoDNR 2014c), were followed when collecting sediment samples.

2.7 Data Analysis

Physicochemical data were examined by analyte to determine whether stations had violations of the Missouri WQS (MoDNR 2014a). Results from the sediment samples for total recoverable

metals and BNAs were compared to Probable Effects Concentrations (**PEC**), Probable Effects Quotients (**PEQ**), Σ PEQ, and average PEQ as described in MacDonald et al. (2000) and MacDonald et al. (2009). Sampling stations that had values not in compliance with the WQS or recommend U.S. Environmental Protection Agency (U.S. EPA) recommended reference values will be discussed with possible influences being identified.

2.8 Quality Assurance/Quality Control (QA/QC)

2.8.1 Field Meters

All field meters used to collect water quality parameters were maintained in accordance with the Standard Operating Procedure MDNR-ESP-213, *Quality Control Procedures for Checking Water Quality Field Instruments* (MoDNR 2010d).

2.8.2 Biological Samples

Steps to assure accuracy of organism removal from sample debris were performed consistent with those methods found in the SMSBPP document (MoDNR 2012a).

2.8.3 Biological Data Entry

All macroinvertebrate data were entered into the WQMS macroinvertebrate database consistent with the Standard Operating Procedure MDNR-ESP-214, *Quality Control Procedures for Data Processing* (MoDNR 2014d).

2.8.4 Duplicate Sample Collection

Duplicate samples are collected at three randomly selected sampling stations per sampling season for macroinvertebrates and for 10 percent of water samples. No duplicate macroinvertebrate or water samples were collected for this study.

3.0 Results

3.1 Stream Habitat Assessment

Table 3 provides habitat assessment scores for the Pearson Creek test stations and the North Fork White River biological criteria reference station. Stream habitat data were collected in September of 2013 with Carl Wakefield and Mike Irwin performing the assessment. SHAPP guidance states that test stations scoring at least 75 percent of the total score of a reference station should support a similar biological community. Because the Pearson Creek stream habitat assessment scores were ≥ 75 percent of the reference station score, test stations should be capable of supporting a similar macroinvertebrate community. Many of the Pearson Creek habitat metric scores either were in the optimal or suboptimal range, indicating good habitat quality. However, there were some metrics that did not score as well at the Pearson Creek test stations. Metrics that did not perform as well at Pearson Creek #1 were channel flow status, riffle quality, right bank stability, and vegetative protection for both banks. At Pearson Creek #3, epifaunal substrate, channel flow status, riffle quality, right bank stability, vegetative protection for both banks, and the left riparian zone width had values in the marginal or poor category. Metrics that had values in the marginal or poor category at Pearson Creek #4 were riffle quality, vegetative protection for both banks, and riparian zone width for both banks.

Table 3
 Predominant Category Habitat Values, Category Habitat Scores, and Total Habitat Scores from
 Stream Habitat Assessments for Pearson Creek Test Stations and the North Fork of the White
 River Biological Criteria Reference Station

Stream Habitat Parameters	Pearson Creek #1	Pearson Creek #3	Pearson Creek #4	North Fork White River #1
Macroinvertebrate Sample Number	14942	14941	14940	
Stream Habitat Assessment Date	09/23/2014	09/23/2013	09/23/2013	09/24/2013
Epifaunal Substrate/Available Cover	II (11)	III (8)	II (15)	II (12)
Embeddedness	I (17)	I (17)	I (17)	I (18)
Velocity/Depth Regime	I (18)	I (16)	II (11)	I (18)
Sediment Deposition	II (13)	II (15)	II (15)	III (8)
Channel Flow Status	III (8)	III (10)	II (14)	III (10)
Channel Alteration	I (20)	I (20)	I (20)	I (20)
Riffle Quality	III (10)	III (8)	III (10)	II (11)
Bank Stability – Left Bank	I (9)	I (9)	I (10)	II (7)
Bank Stability – Right Bank	III (5)	III (5)	I (10)	I (10)
Vegetative Protection – Left Bank	III (4)	IV (2)	IV (1)	IV (2)
Vegetative Protection – Right Bank	IV (0)	IV (1)	III (4)	III (4)
Riparian Zone Width – Left Bank	I (9)	III (5)	III (4)	I (10)
Riparian Zone Width – Right Bank	I (9)	I (9)	IV (2)	I (10)
Total Habitat Score	133	125	133	140
Percent of Reference Score	95.0	89.3	95.0	N/A

Habitat parameter categories range from I to IV with category I = optimal, category II = suboptimal, category III = marginal, and category IV = poor. Habitat parameter scores are listed in parentheses and range from 0 to 20 except for vegetative protection and riparian zone categories, which range from 0 to 10.

3.2 Macroinvertebrate Biological Assessment

3.2.1 Semi-quantitative Macroinvertebrate Stream Bioassessment Project Procedure (SMSBPP)

Ozark/White EDU Biological Criteria Scoring

MSCI scores were calculated for Pearson Creek test stations using riffle/pool perennial/wadeable biological criteria for the Ozark/White EDU (Table 4). Pearson Creek #1 had a partially supporting score of 12, and the other two test stations had partially supporting scores of 14 during both sampling seasons. All of the biological metrics at Pearson Creek #1 had suboptimal scores (each metric had a score of 3) during the fall 2014 sampling season. At Pearson Creek #3

and #4, the SDI value was in the fully supporting range (metric score of 5), but the other three metric values were suboptimal.

During the spring 2015 sampling season, SDI was in the fully supporting range, TR and BI were in the partially supporting range, and EPTT was in the non-supporting range at Pearson Creek #1. At Pearson Creek #3 and #4, SDI was in the fully supporting range, but the other three metrics were suboptimal.

Table 4
 Fall 2014 and Spring 2015 Riffle/Pool Ozark/White EDU Stream Biological Criteria, Biological Support Categories, Biological Metric Values and Scores shown in Parentheses, and Macroinvertebrate Stream Condition Index (MSCI) Scores for Pearson Creek Sampling Stations

Station	Sample No.	Taxa Richness	EPTT	Biotic Index	SDI	MSCI	Support
Fall 2014							
Pearson Creek #1	14942	73 (3)	13 (3)	5.6 (3)	3.16 (3)	12	Partially Supporting
Pearson Creek #3	14941	74 (3)	17 (3)	5.5 (3)	3.34 (5)	14	Partially Supporting
Pearson Creek #4	14940	67 (3)	15 (3)	5.4 (3)	3.27 (5)	14	Partially Supporting
Ozark/White Fall Season Biological Criteria							
Score of 5	If	>79	>25	<5.0	>3.17	20-16	Fully Supporting
Score of 3	If	79-39	25-13	5.0-7.5	3.17-1.59	14-10	Partially Supporting
Score of 1	If	<39	<13	>7.5	<1.59	8-4	Non Supporting
Spring 2015							
Pearson Creek #1	15105	71 (3)	12 (1)	5.5 (3)	3.28 (5)	12	Partially Supporting
Pearson Creek #3	15106	75 (3)	19 (3)	5.0 (3)	3.39 (5)	14	Partially Supporting
Pearson Creek #4	15107	92 (3)	21 (3)	5.4 (3)	3.45 (5)	14	Partially Supporting
Ozark/White Spring Season Biological Criteria							
Score of 5	If	>95	>31	<4.7	>3.26	20-16	Fully Supporting
Score of 3	If	95 - 47	31 - 15	4.7 - 7.3	3.26 - 1.63	14-10	Partially Supporting
Score of 1	If	<47	<15	>7.3	<1.63	8-4	Non Supporting

3.2.2 Macroinvertebrate Percent and Community Composition

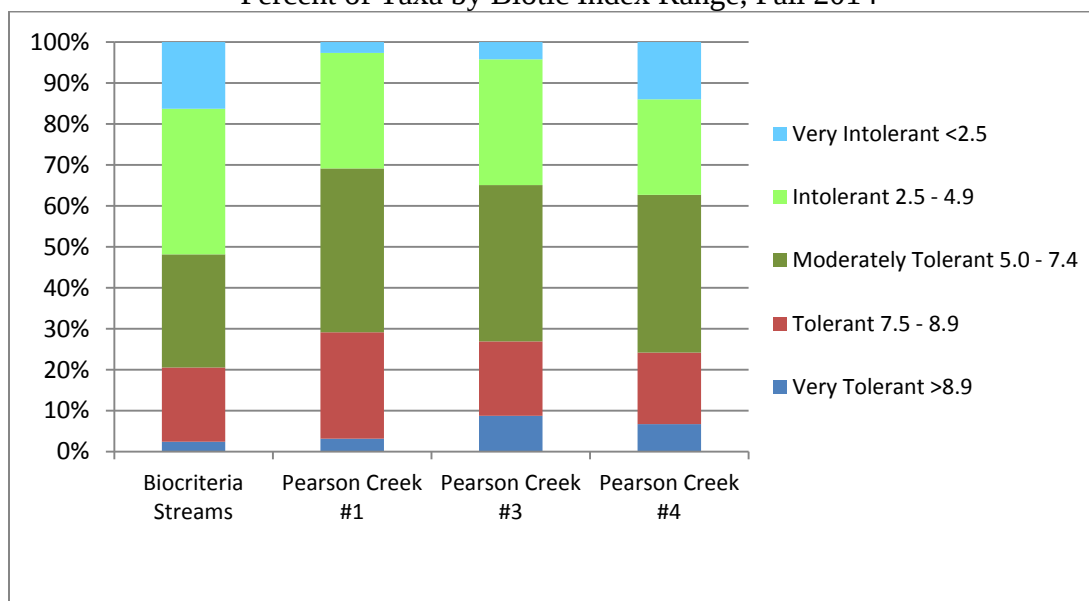
The percent composition of sensitive taxa, FFG, EPTT, and the five dominant macroinvertebrate families and taxa at each station are presented in Figures 3-6 and Tables 5-8. Values in bold type represent the five dominant macroinvertebrate families and taxa for each station.

3.2.2.1 Fall 2014 Sampling Season

Percent Composition of Sensitive Taxa

Taxa found in Pearson Creek samples were generally more tolerant of organic pollution than the biological criteria reference streams (Figure 3 and Table 5). The percentage of Pearson Creek samples made up of taxa with BI values ≥ 5.0 was much higher compared to the biological criteria reference streams. Pearson Creek samples also had a much lower percentage of taxa with BI values < 5.0 than reference streams. The percentage of taxa from the Pearson Creek test stations with BI values ≥ 5.0 ranged from about 63 at station #4 to about 69 percent at station #1. By comparison, 48 percent of reference stream samples were in this range. For taxa with BI values < 5.0 , the percentage ranged from about 31 percent at station #1 to 37 percent at station #4. Reference stream samples had 52 percent of taxa in this range.

Figure 3
 Percent of Taxa by Biotic Index Range, Fall 2014



Percent Composition of Functional Feeding Groups (FFG)

Gatherer-collectors and scrapers were the two most abundant FFGs at Pearson Creek stations during the fall 2013 sampling season (Figure 4 and Table 5). Gatherer-collectors were the most abundant FFG at the Pearson Creek test stations and were higher than the samples collected from the biological criteria streams. Even though scrapers were the second highest FFG at Pearson Creek, the values were lower compared to the biological criteria reference data. The percentage of filterers ranged from about 15 to 20 percent among Pearson Creek test stations, compared to about 11 percent for the biological criteria reference streams. The percentage of predators was lower among Pearson Creek stations, ranging from about 6 to 10 percent, compared to about 11 percent at the biological reference streams.

Figure 4
Percent of Taxa by Functional Feeding Group, Fall 2014

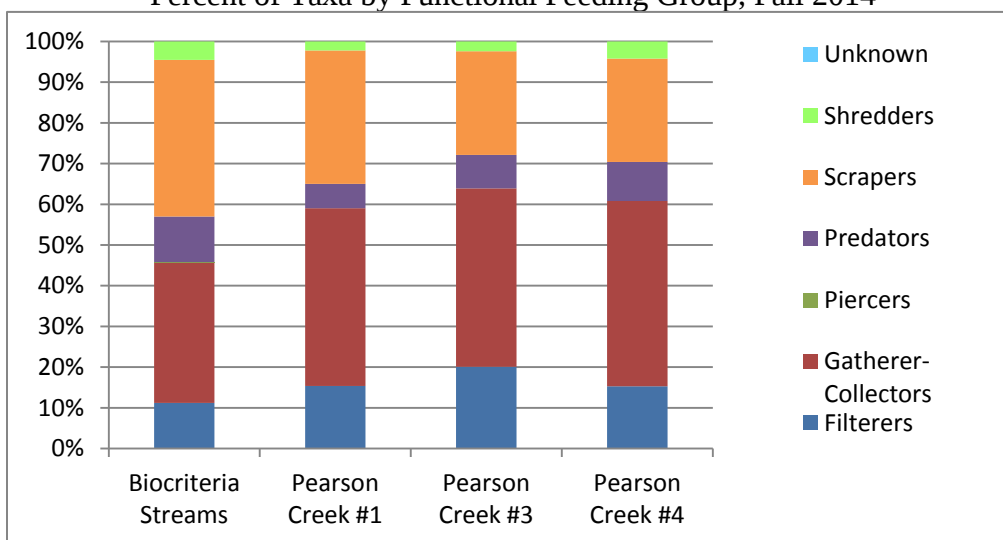


Table 5
Biological Metric Values for Sensitive Taxa and Functional Feeding Group (FFG) Metrics at Biological Criteria Reference Samples and Pearson Creek Test Stations, Fall 2014

Variable-Station	Biocriteria Reference Data	Pearson Creek #1	Pearson Creek #3	Pearson Creek #4
Sample Number		14942	14941	14940
Sensitive Taxa				
% Biotic Index >8.9	2.4	3.2	8.7	6.7
% Biotic Index 7.5-8.9	18.1	26.0	18.2	17.4
% Biotic Index 5.0-7.4	27.6	40.0	38.2	38.5
% Biotic Index 2.5-4.9	25.6	28.2	30.7	23.3
% Biotic Index <2.5	16.3	2.7	4.2	14.0
Functional Feeding Groups				
% Filterers	11.2	15.4	20.1	15.3
% Gatherer-Collectors	34.5	43.7	43.9	45.5
% Parasites	--	--	--	--
% Piercers	0.1	--	--	--
% Predators	11.2	6.0	8.2	9.6
% Scrapers	38.5	32.8	25.4	25.4
% Shredders	4.5	2.2	2.4	4.2
% Unknown	0.01	--	--	--

Biocriteria reference stream data values are average percent

Macroinvertebrate Community Composition

During the fall 2014 sampling season, percent EPTT and percent Ephemeroptera ranged from slightly lower at stations #3 and #4 to much lower at station #1 compared to biological criteria reference data (Table 6). Percent Plecoptera values at stations #3 and #4 were similar to the biological criteria reference streams, but no stoneflies were found in the station #1 sample.

Percent Trichoptera was similar at station #1 and higher at the other two test stations compared to the biological reference streams.

Table 6
Percent EPTT, Dominant Macroinvertebrate Families, and Taxa at Pearson Creek Test Stations and Ozark/White EDU Biological Criteria Reference Samples, Fall 2014

Variable-Station	Biotic Index	Ozark/White Reference Streams	Pearson Creek #1	Pearson Creek #3	Pearson Creek #4
Sample Number			14942	14941	14940
EPTT Metrics (%)					
EPTT		39.5	25.3	35.9	36.1
Ephemeroptera		29.4	15.9	20.3	23.1
Plecoptera		0.3	--	0.6	0.5
Trichoptera		9.8	9.4	15.0	12.5
Percent Dominant Families					
Chironomidae		13.9	15.2	21.2	17.2
Elmidae		12.9	24.2	7.5	18.0
Heptageniidae		9.1	7.6	7.8	6.4
Psephenidae		8.1	0.4	11.9	0.6
Caenidae		6.9	0.2	8.7	4.2
Baetidae		3.2	7.8	2.3	2.2
Crangonyctidae		--	7.6	0.4	5.8
Planariidae		0.5	7.6	2.8	3.6
Leptophlebiidae		3.6	0.3	1.5	10.3
Hydropsychidae		3.6	4.5	6.2	7.7
Percent Dominant Taxa					
<i>Optioservus sandersoni</i>	2.7	9.2	19.7	4.7	13.8
<i>Psephenus herricki</i>	2.5	7.6	0.4	11.8	0.2
<i>Hyaella azteca</i>	7.9	5.7	3.1	4.7	1.0
<i>Elimia</i>	2.5	5.0	0.7	0.1	3.0
<i>Maccaffertium mediopunctatum</i>	1.7	4.0	--	--	--
<i>Crangonyx</i>	8.0	--	7.6	0.4	5.8
Planariidae	7.5	0.5	7.6	2.9	3.6
<i>Stenacron</i>	7.1	0.2	7.3	4.1	5.9
<i>Lirceus</i>	7.7	0.1	4.8	--	0.4
<i>Caenis latipennis</i>	7.6	2.3	0.2	8.7	4.2
Tubificidae	9.2	1.2	2.7	7.5	5.8
<i>Chimarra</i>	2.8	0.3	4.2	7.0	1.8
<i>Cheumatopsyche</i>	6.6	2.3	4.5	6.3	7.6
Leptophlebiidae	2.0	1.5	0.3	1.5	10.3

Biocriteria reference stream data values are average percent

Values in bold type represent the five dominant macroinvertebrate taxa for each station.

All three Pearson Creek stations generally had high abundances of the macroinvertebrate families Chironomidae, Elmidae, and Heptageniidae. There were no chironomid taxa that dominated the samples, but *Micropsectra*, *Rheotanytarsus*, *Tanytarsus*, and *Stempellinella* from the tribe Tanytarsini and *Paratendipes* from the tribe Chironomini were common in all of the samples. Most of the elmids beetle abundance was made up of *Optioservus sandersoni*, and this species was especially abundant at station #1. Most of the heptageniid mayfly abundance was made up of *Stenacron*. There were some differences in the other dominant macroinvertebrate taxa among test stations. The baetid mayfly *Dipheter* was much more abundant at station #1 than other two stations. The amphipod *Crangonyx* was abundant at stations #1 and #4, but it was

not abundant at station #3. Planariidae and the isopod *Lirceus* was much more abundant at station #1 than the other two stations. The water penny *Psephenus herricki*, the caenid mayfly *Caenis latipennis*, and the philopotamid caddisfly *Chimarra* were more abundant at station #3 than the other stations. Tubificid worms and the hydropsychid caddisfly *Cheumatopsyche* were more abundant at station #3 and #4 than station #1. Leptophlebiid mayflies were much more abundant at station #4 than the other stations.

Optioservus sandersoni and *Psephenus herricki* were dominant taxa among biological criteria reference stream samples. These were the only two taxa that were also dominant at one or more of the Pearson Creek stations. The other three dominant taxa from the biological criteria reference streams either were not present or were found in lower abundance at the test stations. The heptageniid mayfly *Maccaffertium mediopunctatum* made up an average of 4 percent of the biological criteria reference stream samples, but they were not collected in the Pearson Creek test stations. The other two taxa, the amphipod *Hyaella azteca* and the snail *Elimia* from the family Pleuroceridae, were found in Pearson Creek samples, but they were more abundant in the biological criteria reference streams. Except for *Hyaella azteca*, the dominant taxa from the biological criteria streams had low BI values. Among Pearson Creek test stations, the majority of dominant taxa had BI values in the moderately tolerant (BI = 5.0-7.4) or tolerant range (BI = 7.5-8.9). Exceptions to this at one or more of the test stations were *Optioservus sandersoni*, *Psephenus herricki*, and *Chimarra*, all of which had low BI values (2.7, 2.5, and 2.8, respectively).

3.2.2.2 Spring 2015 Sampling Season

Percent Composition of Sensitive Taxa

Taxa found in Pearson Creek samples were generally more tolerant of organic pollution than the biological criteria reference streams (Figure 5 and Table 7). The percentage of taxa from the Pearson Creek stations that were in the very tolerant range (BI >8.9), the tolerant range (BI = 7.5-8.9), and the moderately tolerant range (BI = 5.0-7.4) was higher than the biological criteria reference streams. Percent of taxa that were in the sensitive range (BI = 2.5-4.9) and the very sensitive range (BI <2.5) were more abundant in the biological reference streams than the Pearson Creek stations. All Pearson Creek stations had a lower percentage of taxa in the very sensitive range compared to reference conditions. There was, however, a higher percentage of sensitive taxa in test stations upstream of the Jones Branch confluence (stations #3 and #4).

Figure 5
Percent of Taxa by Biotic Index Range, Spring 2015

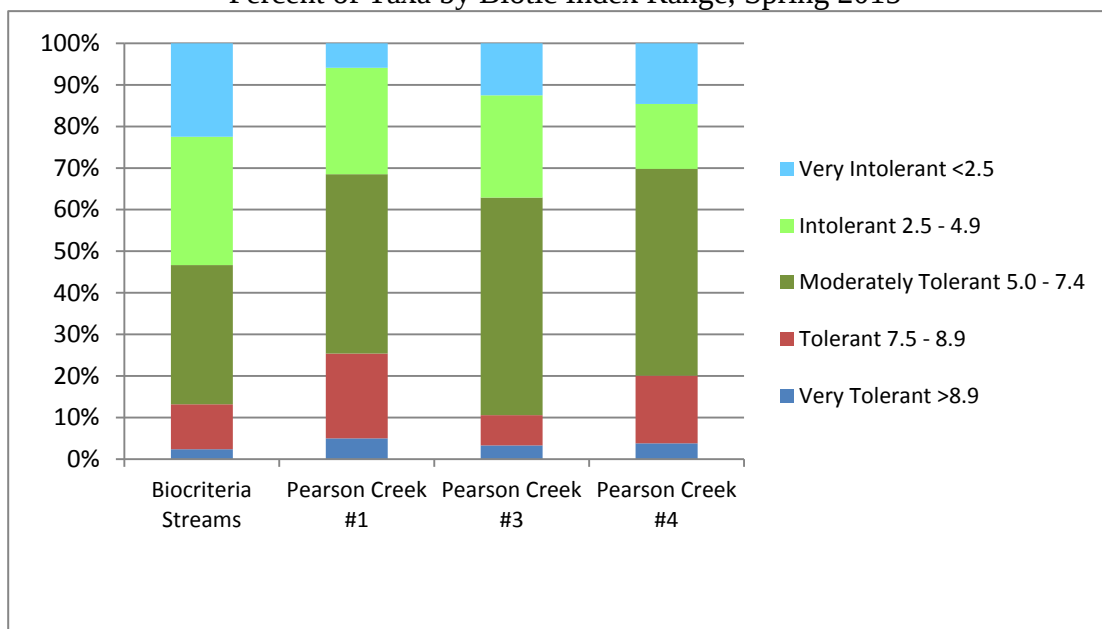


Table 7
Biological Metric Values for Sensitive Taxa and Functional Feeding Group (FFG) Metrics at Biological Criteria Reference Samples and Pearson Creek Test Stations, Spring 2015

Variable-Station	Biocriteria Reference Data	Pearson Creek #1	Pearson Creek #3	Pearson Creek #4
Sample Number		15105	15106	15107
Sensitive Taxa				
% Biotic Index >8.9	2.4	5.0	3.3	3.8
% Biotic Index 7.5-8.9	10.8	20.4	7.3	16.3
% Biotic Index 5.0-7.4	33.5	43.2	52.3	49.7
% Biotic Index 2.5-4.9	30.9	25.6	24.6	15.6
% Biotic Index <2.5	22.5	5.9	12.5	14.6
Functional Feeding Groups				
% Filterers	7.3	7.4	9.2	8.2
% Gatherer-Collectors	35.8	62.7	59.4	45.7
% Parasites	0.01	--	--	--
% Piercers	0.2	0.3	3.2	0.1
% Predators	14.1	4.9	7.1	14.0
% Scrapers	31.9	16.4	9.4	13.4
% Shredders	10.7	8.4	11.7	18.7
% Unknown	0.03	--	--	--

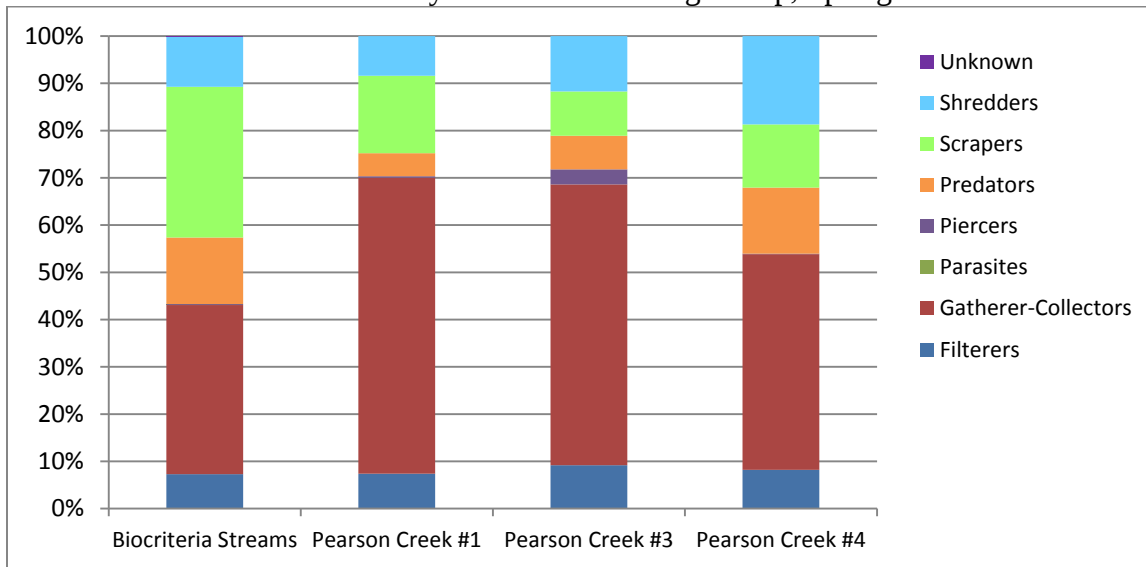
Biocriteria and candidate reference stream data values are average percent

Percent Composition of Functional Feeding Groups (FFG)

Gatherer-collectors were the most abundant FFG at Pearson Creek test stations and were much higher in abundance than the biological criteria data during the spring 2015 sampling season (Figure 6 and Table 7). Percent scrapers ranged from about 9 to 16 percent at the Pearson Creek stations. By comparison, scrapers made up about 32 percent of biological criteria reference

stream samples. Among test stations percent shredders ranged from slightly lower (8.4 percent at test station #1) to higher (18.7 percent at test station #4) compared to reference conditions (10.7 percent). Compared to reference conditions (14.1 percent), percent predators ranged from a lower value at test station #1 (4.9 percent) to a similar value at test station #4 (14.9 percent). Percent filterers ranged from a similar value at test station #1 (7.4 percent) to a slightly higher value at test station #3 (9.2 percent) compared to the biological criteria streams (7.3 percent).

Figure 6
Percent of Taxa by Functional Feeding Group, Spring 2015



Macroinvertebrate Community Composition

During the spring 2015 sampling season, percent EPTT and percent Ephemeroptera were much lower at Pearson Creek stations compared to biological criteria reference data (Table 8). Percent Plecoptera values at stations #3 and #4 were slightly lower than the biological criteria reference streams, and no Plecoptera specimens were found at test station #1. Trichoptera made up a similar percentage of Pearson Creek #1 and #4 samples compared to reference sites. Station #3, however, had a higher percentage of Trichoptera than references.

All three Pearson Creek stations generally had a high abundance of chironomid taxa compared to reference conditions during the spring 2015 sampling season. Chironomid taxa *Cricotopus/Orthocladius* grp., *Micropsectra*, and *Paratendipes* were abundant at all of the Pearson Creek stations. *Cricotopus/Orthocladius* grp. abundance among Pearson Creek stations ranged from slightly lower to slightly higher than reference conditions, but the other two chironomid taxa had considerably higher abundances than the biological criteria reference streams. Other chironomid taxa were more abundant at some test stations than reference conditions. *Eukiefferiella* was abundant at stations #1 and #3. At stations #3, *Rheocricotopus* and *Stempellinella* also were abundant. The elmid beetle *Optioservus sandersoni* was more abundant at test stations #1 and #4 than the biological criteria reference streams. At station #1 the isopod *Lirceus* was more abundant, and at test stations #1 and #4 the amphipod *Crangonyx* was

more abundant than reference conditions. Baetid mayflies, made up primarily of the genus *Dipheter*, were more abundant at Pearson Creek stations than biological criteria reference streams. The majority of stoneflies occurring at stations #3 and #4 were from the family Leuctridae.

Table 8
Percent EPTT, Dominant Macroinvertebrate Families, and Taxa at Pearson Creek Test Stations and Ozark/White EDU Biological Criteria Reference Samples, Spring 2015

Variable-Station	Biotic Index	Ozark/White Reference Streams	Pearson Creek #1	Pearson Creek #3	Pearson Creek #4
Sample Number			15105	15106	15107
EPTT Metrics (%)					
EPTT		39.4	12.2	21.1	17.9
Ephemeroptera		30.6	8.3	8.6	11.1
Plecoptera		5.2	--	3.3	3.6
Trichoptera		3.6	3.9	9.2	3.2
Percent Dominant Families					
Chironomidae		29.8	45.5	63.7	52.8
Pleuroceridae		12.4	0.5	1.2	0.5
Heptageniidae		11.8	2.3	3.9	3.8
Ephemerellidae		9.4	--	--	0.1
Elmidae		5.3	13.3	2.5	8.9
Asellidae		0.4	7.7	--	0.8
Crangonyctidae		0.2	6.6	0.2	7.5
Baetidae		0.2	5.8	1.8	4.2
Hydroptilidae		0.1	0.3	3.2	0.1
Leuctridae		0.9	--	3.1	3.4
Tubificidae		1.4	4.4	2.8	2.3
Percent Dominant Taxa					
<i>Elimia</i>	2.5	12.2	0.5	1.0	0.5
<i>Cricotopus/Orthocladius</i> grp.	6.5	6.7	5.4	3.8	9.7
<i>Leucrocuta</i>	0	6.0	--	--	--
<i>Ephemerella invaria</i>	2.2	5.4	--	--	--
<i>Optioservus sandersoni</i>	2.7	3.8	10.9	1.0	6.9
<i>Eukiefferiella</i>	4.0	1.2	8.3	9.5	2.3
<i>Lirceus</i>	7.7	0.3	7.5	--	0.2
<i>Paratendipes</i>	5.3	0.2	7.5	14.4	6.0
<i>Crangonyx</i>	8.0	0.1	6.4	0.2	7.5
<i>Micropsectra</i>	1.4	0.4	5.5	8.6	9.1
<i>Rheocricotopus</i>	7.3	0.1	--	6.8	0.5
<i>Stempellinella</i>	5.3	1.4	1.4	4.0	1.0
<i>Thienemannimyia</i> grp.	6.0	3.1	1.9	1.8	6.6

Biocriteria reference stream data values are average percent

Values in bold type represent the five dominant macroinvertebrate taxa for each station.

Two dominant taxa common to both reference streams and at least one Pearson Creek site were *Cricotopus/Orthocladius* grp. and *Optioservus sandersoni*. The other three dominant taxa from the biological criteria reference streams either were not present or were found in lower abundance among test stations. The heptageniid mayfly *Leucrocuta* and the ephemerellid mayfly *Ephemerella invaria* were abundant in biological criteria reference streams, but they were not collected in Pearson Creek stations. Although the pleurocerid snail *Elimia* was found in low abundance at Pearson Creek stations, they were the most abundant taxon found in biological criteria reference streams. Except for *Cricotopus/Orthocladius* grp., the dominant taxa from the

biological criteria streams had low BI values. Dominant taxa BI values among Pearson Creek sites ranged from the very intolerant *Micropsectra* (BI = 1.4) to the tolerant *Crangonyx* (BI = 8.0).

3.3 Physicochemical Water Data

Water samples and field measurements were collected during the fall 2014 and spring 2015 macroinvertebrate sampling periods (Tables 9 and 10). Results showed that most of the nutrient parameters were elevated compared to the U.S. EPA Nutrient Criteria recommended reference values for the Level III Ozark Highlands ecoregion (U.S. EPA 2000). Physicochemical results are arranged to demonstrate trends of certain variables that may suggest a source of effects at the Pearson Creek test stations. Results shown here are for stream discharge, nitrate + nitrite-N, total nitrogen, total phosphorus, and turbidity by season.

3.3.1 Stream Discharge

Discharge at the Pearson Creek test stations ranged from 3.8 cfs at station #4 to 9.6 cfs at station #1 (Table 9) during the fall 2014 sampling season. No discharge measurement was taken at Jones Branch during the fall 2014 sampling season.

Discharge was higher during the spring 2015 sampling season at the Pearson Creek stations, ranging from 12.2 cfs at station #4 to 26.6 cfs at station #1 (Table 10). At Jones Branch, discharge was 4.0 cfs.

3.3.2 Nitrate + Nitrite-N

During the fall 2014 sampling season, all Pearson Creek samples and the Jones Branch sample had nitrate + nitrite-N concentrations above the U.S. EPA recommended reference value (0.24 mg/L) for the Level III Ozark Highlands ecoregion (U.S. EPA 2000). Pearson Creek nitrate + nitrite-N concentrations ranged from 1.79 mg/L at station #3 to 2.49 mg/L at station #1 (Table 9). The Jones Branch nitrate + nitrite-N concentration was 2.68 mg/L.

Nitrate + nitrite-N concentrations also were higher than the U.S. EPA recommended reference value during the spring 2015 sampling season (Table 10). Pearson Creek nitrate + nitrite-N concentrations ranged from 1.72 mg/L at station #3 to 2.37 mg/L at station #1. The Jones Branch nitrate + nitrite-N concentration was 2.84 mg/L.

3.3.3 Total Nitrogen

During the fall 2014 sampling season, all of the Pearson Creek samples and the Jones Branch sample had total nitrogen concentrations above the U.S. EPA recommended reference value (0.29 mg/L) for the Level III Ozark Highlands ecoregion (U.S. EPA 2000). Pearson Creek total nitrogen concentrations ranged from 1.67 mg/L at station #3 to 2.29 mg/L at station #1 (Table 9). The Jones Branch nitrate + nitrite-N concentration was 2.40 mg/L.

Total nitrogen concentrations also were higher than the U.S. EPA recommended reference value during the spring 2015 sampling season (Table 10). Pearson Creek total nitrogen concentrations ranged from 1.73 mg/L at station #3 to 2.35 mg/L at station #1. The Jones Branch nitrate + nitrite-N concentration was 2.78 mg/L.

Table 9
 Physicochemical Variables for Surface Water Samples at Pearson Creek Bioassessment Study
 Sampling Stations, Fall 2014

	Pearson Creek #1	Jones Branch #1	Pearson Creek #3	Pearson Creek #4
Invertebrate Sample Number	14942	--	14941	14940
Physicochemical Sample Number	1411953	1411954	1411952	1411951
Sample Date	09/23/2014	09/23/2014	09/23/2014	09/23/2014
Sample Time	1515	1705	1100	1310
Ammonia	<0.03 ^a	<0.03 ^a	<0.03 ^a	<0.03 ^a
Chloride	20.8	34.7	15.1	16.6
Sulfate	8.62	10.0	6.93	7.04
Dissolved Calcium	85.9	97.6	73.2	71.5
Dissolved Magnesium	4.80	2.84	6.14	5.89
Dissolved Hardness as CaCO ₃	234	255	208	203
Dissolved Oxygen	9.80	9.67	9.50	9.78
Discharge (cfs)	9.62	--	4.36	3.83
pH (Units)	7.9	8.3	8.3	8.2
Conductivity (µmhos/cm)	495	562	434	430
Temperature (°C)	18.4	18.4	15.3	15.8
Turbidity (NTU)	2.10	2.31	1.56	1.06
Total Suspended Solids	<5 ^a	<5 ^a	<5 ^a	<5 ^a
Nitrate + Nitrite	2.49^b	2.68	1.79	1.92
Total Nitrogen	2.29	2.40	1.67	1.83
Total Phosphorus	0.04	0.02	0.04	0.04
Dissolved Arsenic (µg/L)	<0.50 ^a	<0.50 ^a	<0.50 ^a	<0.50 ^a
Dissolved Barium (µg/L)	80.7	82.7	65.0	64.5
Dissolved Cadmium (µg/L)	<0.10 ^a	<0.10 ^a	<0.10 ^a	<0.10 ^a
Dissolved Chromium (µg/L)	4.62	4.80	3.36	4.70
Dissolved Cobalt (µg/L)	<1 ^a	<1 ^a	<1 ^a	<1 ^a
Dissolved Copper (µg/L)	0.60 ^c	<0.50 ^a	<0.50 ^a	<0.50 ^a
Dissolved Lead (µg/L)	<0.50 ^a	<0.50 ^a	<0.50 ^a	<0.50 ^a
Dissolved Manganese (µg/L)	7.99	15.7	5.76	8.00
Dissolved Mercury (µg/L)	<0.10 ^a	<0.10 ^a	<0.10 ^a	<0.10 ^a
Dissolved Nickel (µg/L)	1.11	1.44	0.90 ^c	0.92 ^c
Dissolved Selenium (µg/L)	<1 ^a	1.10 ^c	<1 ^a	<1 ^a
Dissolved Thallium (µg/L)	<0.50 ^a	<0.50 ^a	<0.50 ^a	<0.50 ^a
Dissolved Zinc (µg/L)	5.98	1.84	2.47	1.49

^a Below detectable limits

^b Sample was diluted during analysis

^c Estimated value, detected below Practical Quantitation Limit

Units mg/L unless otherwise noted. Values in bold exceed Missouri Water Quality Standards or are elevated compared to U.S. EPA recommended reference condition values.

Table 10
 Physicochemical Variables for Surface Water Samples at Pearson Creek Bioassessment Study
 Sampling Stations, Spring 2015

	Pearson Creek #1	Jones Branch #1	Pearson Creek #3	Pearson Creek #4
Invertebrate Sample Number	15105	--	15106	15107
Physicochemical Sample Number	151841	151844	151842	151843
Sample Date	03/25/2015	03/25/2015	03/25/2015	03/25/2015
Sample Time	1025	1410	1135	1245
Ammonia	<0.03 ^a	<0.03 ^a	<0.03 ^a	<0.03 ^a
Chloride	23.9	62.0	14.4	15.7
Sulfate	11.4	14.9	10.3	9.58
Dissolved Calcium	85.2	108	72.1	71.2
Dissolved Magnesium	4.64	3.17	5.43	5.35
Dissolved Hardness as CaCO ₃	232	283	202	200
Dissolved Oxygen	10.99	10.58	12.18	11.75
Discharge (cfs)	26.55	4.00	14.42	12.15
pH (Units)	7.9	7.9	7.9	8.0
Conductivity (µmhos/cm)	456	607	382	378
Temperature (°C)	13.0	15.3	12.7	13.8
Turbidity (NTU)	2.50	1.87	1.85	1.43
Total Suspended Solids	<5 ^a	<5 ^a	<5 ^a	<5 ^a
Nitrate + Nitrite	2.37^b	2.84^b	1.72	1.78
Total Nitrogen	2.35	2.78	1.73	1.78
Total Phosphorus	<0.01 ^a	<0.01 ^a	<0.01 ^a	<0.01 ^a
Dissolved Arsenic (µg/L)	<0.50 ^a	<0.50 ^a	<0.50 ^a	<0.50 ^a
Dissolved Barium (µg/L)	63.7	79.1	55.9	52.8
Dissolved Cadmium (µg/L)	<0.10 ^a	<0.10 ^a	<0.10 ^a	<0.10 ^a
Dissolved Chromium (µg/L)	2.83	2.51	2.56	2.01
Dissolved Cobalt (µg/L)	<1 ^a	<1 ^a	<1 ^a	<1 ^a
Dissolved Copper (µg/L)	<0.50 ^a	0.59 ^c	<0.50 ^a	<0.50 ^a
Dissolved Lead (µg/L)	<0.50 ^a	<0.50 ^a	<0.50 ^a	<0.50 ^a
Dissolved Manganese (µg/L)	4.65	11.5	4.81	7.65
Dissolved Mercury (µg/L)	0.13 ^c	<0.10 ^a	<0.10 ^a	<0.10 ^a
Dissolved Nickel (µg/L)	0.64 ^c	0.76 ^c	0.52 ^c	0.50 ^c
Dissolved Selenium (µg/L)	<1 ^a	<1 ^a	<1 ^a	<1 ^a
Dissolved Thallium (µg/L)	<0.50 ^a	<0.50 ^a	<0.50 ^a	<0.50 ^a
Dissolved Zinc (µg/L)	4.44	3.00	3.35	2.85

^a Below detectable limits

^b Sample was diluted during analysis

^c Estimated value, detected below Practical Quantitation Limit

Units mg/L unless otherwise noted. Values in bold exceed Missouri Water Quality Standards or are elevated compared to U.S. EPA recommended reference condition values.

3.3.4 Total Phosphorus

Total phosphorous was higher than the U.S. EPA recommended reference value (0.007 mg/L) for the Level III Ozark Highlands ecoregion (U.S. EPA 2000) during the fall 2014 sampling season at all of the Pearson Creek stations and Jones Branch. The Pearson Creek total phosphorus concentration was 0.04 mg/L at all stations and 0.02 mg/L at Jones Branch (Table 9).

Total phosphorus was below the detection limit of 0.01 mg/L at all of the Pearson Creek stations and Jones Branch during the spring 2015 sampling season (Table 10).

3.3.5 Turbidity

All Pearson Creek sites except station #4 had turbidity readings that were higher than the U.S. EPA recommended reference value of 1.43 NTU (U.S. EPA 2000) in fall 2014. Jones Branch turbidity also was above the U.S. EPA turbidity recommendation. Pearson Creek turbidity ranged from 1.06 NTU at station #4 to 2.10 at station #1 (Table 9). Turbidity was 2.31 NTU at Jones Branch.

Turbidity was also elevated compared to the U.S. EPA recommended reference value at all of the sampling stations except station #4 during the spring 2015 sampling season. Turbidity at Pearson Creek ranged from 1.43 NTU at station #4 to 2.50 NTU at station #1 (Table 10). Turbidity was 1.87 NTU at Jones Branch.

3.4 Fine Sediment Characterization

Sediment samples were collected during the fall 2014 and spring 2015 sampling seasons (Tables 11 and 12). Sediment samples were analyzed for total recoverable metals and BNAs. No sediment sample was collected at Pearson Creek #4 due to the lack of fine sediment during the fall 2014 sampling season. Laboratory equipment failure prevented BNA analysis for the spring 2015 samples collected at Jones Branch and Pearson Creek #4. Mercury was analyzed during the fall 2014 sampling season, but was not analyzed during spring 2015 sampling season because of laboratory error. Results of analyses for metals and polycyclic aromatic hydrocarbons (PAHs), a subset of BNAs, are presented in Tables 11 and 12 to demonstrate trends that may identify a source of effects at Pearson Creek test stations. Other BNAs that did not have PEC values also were analyzed from the sediment samples and can be found in Appendix B. None of these other BNAs were above laboratory detection limits.

3.4.1 Metals

Cadmium, lead, and zinc concentrations were elevated at Pearson Creek #1 and Jones Branch compared to the other Pearson Creek test stations, but they were below the PEC thresholds for these metals during both sampling season (Tables 11 and 12).

3.4.1.1 Cadmium

During the fall 2014 sampling season, cadmium ranged from 0.5 mg/kg at station #3 to 2.3 mg/kg at station #1 and Jones Branch. In spring 2015 samples, cadmium levels ranged from 0.3 mg/kg at station #3 to 3.8 mg/kg at Jones Branch. All concentrations were below the cadmium PEC value of 4.98 mg/kg.

3.4.1.2 Lead

During the fall 2014 sampling season, lead ranged from 22.1 mg/kg at station #3 to 48.6 mg/kg at Jones Branch. Lead levels ranged from 16.2 mg/kg at test station #3 to 88.3 mg/kg at Jones Branch during the spring 2015 sampling season. All values were below the lead PEC value of 128 mg/kg.

Table 11
 Sediment Sample Results and Available PEC Values for Metals and Polycyclic Aromatic Hydrocarbons (PAHs) at Pearson Creek Bioassessment Study Stations, Fall 2014

Variable-Station	Pearson Creek #1	Jones Branch	Pearson Creek #3	PEC Value
Sample Number	1411938	1411939	1411937	
Sample Date	09/23/2014	09/23/2014	09/23/2014	
Sample Time	1630	1720	1210	
Percent Moisture	67.4	60.3	61.6	
Metals (mg/kg)				
Arsenic	3.5	1.9	4.8	33.0
Barium	127	119	172	*
Cadmium	2.3	2.3	0.5	4.98
Chromium	23.9	13.4	31	111
Cobalt	11.6	6.1	15	*
Copper	13.9	10.0	13.3	149
Lead	46.8	48.6	22.1	128
Manganese	500	335	1050	*
Mercury	0.08	0.03	0.04	1.06
Nickel	14.1	8.1	20.2	48.6
Selenium	<1.000 ^a	<1.000 ^a	<1.000 ^a	*
Thallium	1.5 ^b	3.4	1.9 ^b	*
Zinc	284	216	76.7	459
PAHs (µg/kg)				
Anthracene	<154 ^{ac}	<126 ^{ac}	<130 ^{ac}	845
Benz[a]anthracence	<154 ^{ac}	<126 ^{ac}	<130 ^{ac}	1050
Benzo(a)pyrene	<154 ^{ac}	<126 ^{ac}	<130 ^{ac}	1450
Chrysene	<154 ^{ac}	<126 ^{ac}	<130 ^{ac}	1290
Fluorene	<154 ^{ac}	<126 ^{ac}	<130 ^{ac}	536
Fluoranthene	<154 ^{ac}	<126 ^{ac}	<130 ^{ac}	2230
Naphthalene	<154 ^{ac}	400 ^c	<130 ^{ac}	561
Phenanthrene	<154 ^{ac}	298 ^c	<130 ^{ac}	1170
Pyrene	<154 ^{ac}	174 ^{bc}	<130 ^{ac}	1520

^aBelow detectable limits

^bEstimated value, detected below Practical Quantitation Limit

^cSample was diluted during analysis

*No PEC values available

Table 12
 Sediment Sample Results and Available PEC Values for Metals and Polycyclic Aromatic Hydrocarbons (PAHs) at Pearson Creek Bioassessment Study Stations, Spring 2015

Variable-Station	Pearson Creek #1	Jones Branch	Pearson Creek #3	Pearson Creek #4	PEC Value
Sample Number	151854	151851	151853	151852	
Sample Date	03/25/2015	03/25/2015	03/25/2015	03/25/2015	
Sample Time	1005	1410	1135	1245	
Percent Moisture	79.1	66.9	63.5	93.9	
Metals (mg/kg)					
Arsenic	3.3	1.5	3.3	2.4	33.0
Barium	126	87.4	110	165	*
Cadmium	2.8	3.8	0.3	0.9	4.98
Chromium	21.2	14.6	24.3	17.5	111
Cobalt	12.1	7.9	11.6	10.7	*
Copper	14.9	10.0	8.6	10.2	149
Lead	49.2	88.3	16.2	17	128
Manganese	589	504	479	1180	*
Nickel	15.1	9.3	14.5	13.4	48.6
Selenium	<1.000 ^a	<1.000 ^a	<1.000 ^a	1.3 ^b	*
Thallium	1.9 ^b	2.6	1.2 ^b	2.8	*
Zinc	353	391	64.2	126	459
Polycyclic Aromatic Hydrocarbons (µg/kg)					
Anthracene	<239 ^{ac}	--	<137 ^{ac}	--	845
Benz[a]anthracence	<239 ^{ac}	--	<137 ^{ac}	--	1050
Benzo(a)pyrene	<239 ^{ac}	--	<137 ^{ac}	--	1450
Chrysene	<239 ^{ac}	--	<137 ^{ac}	--	1290
Fluorene	<239 ^{ac}	--	<137 ^{ac}	--	536
Fluoranthene	<239 ^{ac}	--	<137 ^{ac}	--	2230
Naphthalene	<1440 ^{acd}	--	<822 ^{acd}	--	561
Phenanthrene	<239 ^{ac}	--	<137 ^{ac}	--	1170
Pyrene	<239 ^{ac}	--	<137 ^{ac}	--	1520

^aBelow detectable limits

^bEstimated value, detected below Practical Quantitation Limit

^cSample was diluted during analysis

^dAnalyte present in bank at >1/2 reported value

*No PEC values available

3.4.1.3 Zinc

During the fall 2014 sampling season, zinc ranged from 76.7 mg/kg at station #3 to 284 mg/kg at station #1. Zinc levels ranged from 64.2 mg/kg at test station #3 to 391 mg/kg at Jones Branch during the spring 2015 sampling season. All values were below the zinc PEC value of 459 mg/kg.

3.4.2 Polycyclic Aromatic Hydrocarbons (PAHs)

Most PAH concentrations were below detectable limits and PEC values during both sampling seasons (Tables 11 and 12). Naphthalene and phenanthrene were above the detection limit at Jones Branch during the fall 2014 sampling season, but both were below the PEC values. At Jones Branch naphthalene (400 µg/kg) was slightly lower than the PEC value of 561 µg/kg, but the phenanthrene concentration (298 µg/kg) was much lower than the PEC value of 1170 µg/kg.

All PAH concentrations were below detection limits in spring 2015 samples, but the detection limit for naphthalene at station #1 (<1440 µg/kg) and station #3 (<822 µg/kg) was higher than the PEC value because the laboratory blank during analysis was contaminated. As mentioned earlier, no PAH analysis was performed on samples collected from station #4 and Jones Branch during the spring 2015 sampling season because of laboratory equipment malfunction.

4.0 Data Trends

4.1 Macroinvertebrate Biological Assessment

4.1.1 MSCI and Biological Metrics

A comparison of MSCI scores between the 2004-2005 study, 2013 U.S. EPA unpublished data, and the current study (2014-2015) showed that the Pearson Creek test stations had slightly higher MSCI scores in the current study for both sampling seasons than data collected in previous studies (Table 13). MSCI scores for station #1 increased from 10 to 12 for both seasons in the current study compared to samples collected in previous studies. An increase of one EPTT during the fall 2014 sampling season and a higher SDI value during the spring 2015 sampling season led to the higher MSCI scores at station #1.

Station #1 spring 2013 biological metric values were considerably different compared to samples collected in 2005 and 2015. TR, EPTT, and SDI values all were lower in 2013, resulting in lower scores for TR and SDI compared to 2015. Despite the other metrics, the station #1 BI value was actually lower in 2013 and attained the highest possible individual metric score.

In spring 2005 a duplicate sample was collected at test station #2, which was located just downstream of the confluence of Jones Branch and about 0.75 miles upstream of station #1. This site was not sampled during the 2014-2015 study because of its close proximity to station #1. MSCI scores for duplicate samples #2a and #2b were 12 and 10, respectively. In spring 2005 the station #2 duplicate samples had much higher BI values and much lower SDI values compared to station #1; however the scores for these individual metrics were the same at both sites. The difference in the MSCI scores between the station #2 duplicates was due to fewer EPTT in the #2b duplicate sample. There were no comparisons to be made for station #3 since it was not sampled as part of the 2004-2005 or the 2013 U.S. EPA study.

Table 13
 Riffle/Pool Ozark/White EDU Perennial/Wadeable Biological Criteria, Biological Support
 Categories, and Macroinvertebrate Stream Condition Index (MSCI) Scores at Pearson Creek Test
 Stations

Station	Sample Year	Sample No.	TR	EPTT	BI	SDI	MSCI	Support
Fall Sampling Season								
Pearson Creek #1	2004	0449877	71 (3)	12 (1)	5.6 (3)	2.88 (3)	10	P
	2013	PEARS1-F13	64 (3)	12 (1)	5.1 (3)	3.09 (3)	10	P
	2014	14942	73 (3)	13 (3)	5.6 (3)	3.16 (3)	12	P
Pearson Creek #3	2014	14941	74 (3)	17 (3)	5.5 (3)	3.34 (5)	14	P
Pearson Creek #4	2013	PEARS3-F13	61 (3)	12 (1)	5.4 (3)	2.63 (3)	10	P
	2014	14940	67 (3)	15 (3)	5.4 (3)	3.27 (5)	14	P
Metric Score=5	If		>79	>25	<5.0	>3.17	20-16	Full
Metric Score=3	If		79-39	25-13	5.0-7.5	3.17-1.59	14-10	Partial
Metric Score=1	If		<39	<13	>7.5	<1.59	8-4	Non
Spring Sampling Season								
Pearson Creek #1	2005	0503034	64 (3)	9 (1)	5.9 (3)	3.17 (3)	10	P
	2013	PEARS1-S13	39 (1)	7 (1)	4.6 (5)	2.43 (3)	10	P
	2015	15105	71 (3)	12 (1)	5.5 (3)	3.28 (5)	12	P
Pearson Creek #2a	2005	0503032	69 (3)	15 (3)	6.6 (3)	2.49 (3)	12	P
Pearson Creek #2b	2005	0503033	63 (3)	11 (1)	6.6 (3)	2.60 (3)	10	P
Pearson Creek #3	2015	15106	75 (3)	19 (3)	5.0 (3)	3.39 (5)	14	P
Pearson Creek #4	2013	PEARS3-S13	70 (3)	20 (3)	5.8 (3)	3.15 (3)	12	P
	2015	15107	92 (3)	21 (3)	5.4 (3)	3.45 (5)	14	P
Metric Score=5	If		>95	>31	<4.7	>3.26	20-16	Full
Metric Score=3	If		95-47	31-15	4.7-7.3	3.26-1.63	14-10	Partial
Metric Score=1	If		<47	<15	>7.3	<1.63	8-4	Non

During this current study, stations #3 and #4 had MSCI scores of 14 during both sampling seasons. Station #4 had higher MSCI scores during both sampling seasons for this study compared to U.S. EPA data collected in 2013. During the fall 2015 sampling season, station #4 had an MSCI score of 14 compared to a score of 10 in 2013. An increase in the number of EPTT and a higher SDI value led to the higher MSCI score in fall 2014. The spring station #4 MSCI score increased from 12 in 2013 to 14 in 2015 due to an increase in the SDI value.

Historical macroinvertebrate data was collected by City Utilities of Springfield (Youngsteadt 1995) in 1992 and the Missouri Clean Water Commission in 1964-65 (Missouri Clean Water Commission 1973, 1974). Macroinvertebrate samples were collected in riffles with a 1 square foot Surber Sampler, and 6 square feet were sampled for most samples. For these samples most taxa were identified to genus, but chironomids were identified to family, and oligochaete worms were identified to Oligochaeta. A comparison of biological metrics between sampling periods at Pearson Creek #1 found that TR, EPTT, Ephemeroptera, and Plecoptera values were higher in 1964-65 samples than the 1992 samples (Table 14). Comparing 1992 results with samples collected on Pearson Creek upstream and downstream of Jones Branch showed that all biological metrics were higher at stations upstream of Jones Branch (Table 15).

Table 14
 Averages of Biological Metric Values from Samples Collected at Pearson Creek #1 in 1964-65 and 1992

Station	Sample Years	Sample Size	TR	EPTT	Ephemeroptera	Plecoptera	Trichoptera
Pearson Creek #1	1964-65	4	24.5	12.8	7.3	3.0	2.5
	1992	4	17.8	5.8	2.3	0.8	2.8

Table 15
 Averages of Biological Metric Values from Samples Collected at Pearson Creek Sampling Stations in 1992

Stations	Sample Size	TR	EPTT	Ephemeroptera	Plecoptera	Trichoptera
Upper Pearson Creek	20	22.6	11.6	3.8	2.6	5.2
Lower Pearson Creek	12	18.2	6.1	2.3	0.8	3.0

4.1.2 Macroinvertebrate Community Composition

MoDNR fall samples collected at station #1 in 2004 and 2014 and station #4 in 2014 had higher percent EPTT, Ephemeroptera, and Trichoptera than the fall 2013 U.S. EPA samples (Table 16). Although some Plecoptera individuals were collected in station #3 and #4 MoDNR samples, none were present in the 2013 U.S. EPA sample at Station #4. Plecoptera were absent from all site #1 samples.

There were some differences in the Pearson Creek macroinvertebrate community composition among sample years during the fall sampling season. At station #1, *Optioservus sandersoni* had a much higher abundance in 2004 and 2014 than 2013, but water mites (Acarina), the snail *Elimia*, the black fly *Simulium*, and the chironomid *Rheotanytarsus* were more abundant in 2013. Another difference at station #1 was that the amphipod *Hyaella azteca* and the mayfly *Dipheter* were more abundant in 2004, whereas the percentage of planarians, the amphipod *Crangonyx*, and the mayfly *Stenacron* was higher in 2014. At station #4, *Optioservus sandersoni* was abundant in 2013 and 2014, but there were differences in most of the other dominant taxa between sample years. Water mites, *Elimia*, *Crangonyx*, and the mayfly *Caenis latipennis* were more abundant at station #4 in 2013. In 2014, the caddisfly *Cheumatopsyche*, *Stenacron*, tubificid worms, and leptophlebiid mayflies were more abundant.

Spring 2005 and 2015 MoDNR station #1 samples had higher percent EPTT and Ephemeroptera compared to 2013 U.S. EPA samples (Table 17). Station #1 percent Trichoptera was higher in 2015 than samples collected in 2005 and 2013. MoDNR 2015 station #4 percent EPTT, Ephemeroptera, and Trichoptera were similar to the U.S. EPA 2013 sample, but the percentage of Plecoptera present was much higher in the MoDNR 2015 sample. When comparing among all Pearson Creek samples, EPTT and Plecoptera generally were more abundant among stations upstream of Jones Branch in spring samples.

As was the case with the fall data, there also were some differences in the macroinvertebrate community composition among sample years during the spring sampling season. At station #1, *Optioservus sandersoni*, *Elimia*, and the chironomid *Polypedilum flavum* were more abundant in 2013 than 2005 and 2015. Other differences observed at station #1 included a higher abundance of *Crangonyx* in 2015, a lower abundance of *Lirceus* in the 2013 sample, and a lower abundance of *Cricotopus/Orthocladius* grp. in 2015. At station #4 *Optioservus sandersoni* and the chironomid *Thienemannimyia* grp. were more abundant in 2015, and *Crangonyx* was more abundant in the 2013 sample.

Table 16
 Percent EPT, Dominant Macroinvertebrate Families and Macroinvertebrate Taxa at Pearson
 Creek Test Stations, Fall 2004, 2013, and 2014

Variable-Station	Biotic Index	Pearson Creek #1			Pearson Creek #3	Pearson Creek #4	
Sample Number		0449877	PEARS1-F13	14942	14941	PEARS3-F13	14940
Sample Date		09/29/04	09/17/13	09/23/14	09/23/14	09/17/13	09/23/14
EPT Metrics							
% EPT		25.4	16.1	25.3	35.9	22.8	36.1
% Ephemeroptera		18.2	13.6	15.9	20.3	17.3	23.1
% Plecoptera		--	--	--	0.6	--	0.5
% Trichoptera		7.1	2.5	9.4	15.0	5.5	12.5
Percent Dominant Families							
Elmidae		24.7	7.9	24.2	7.5	15.5	18.0
Baetidae		14.6	10.6	7.8	2.3	0.3	2.2
Chironomidae		11.2	23.5	15.2	21.2	10.3	17.2
Hyalellidae		11.1	1.6	3.1	4.7	5.6	1.0
Hydropsychidae		6.0	1.8	4.5	6.2	3.7	7.7
Arachnida		5.3	16.4	2.3	2.6	27.9	2.6
Pleuroceridae		1.2	15.9	0.7	0.6	5.9	3.0
Simuliidae		2.9	8.4	1.7	1.5	0.1	0.5
Heptageniidae		2.4	1.9	7.6	7.8	2.9	6.4
Crangonyctidae		2.2	2.1	7.6	0.4	8.2	5.8
Planariidae		3.9	0.7	7.6	2.9	--	3.6
Psephenidae		0.2	0.8	0.4	11.9	0.3	0.6
Caenidae		1.0	1.0	0.2	8.7	11.5	4.2
Leptophlebiidae		0.3	0.1	0.3	1.5	2.7	10.3
Percent Dominant Taxa							
<i>Optioservus sandersoni</i>	2.7	23.5	6.5	19.7	4.7	14.0	13.8
<i>Hyalella azteca</i>	7.9	11.1	1.6	3.1	4.7	5.6	1.0
<i>Dipheter</i>	5.0	8.5	3.9	4.0	0.6	0.3	1.8
<i>Baetis</i>	6.0	6.1	6.6	3.6	1.7	--	0.4
<i>Cheumatopsyche</i>	6.6	5.9	1.7	4.5	6.3	3.6	7.6
Acarina	5.7	5.3	16.4	2.3	2.6	28.0	2.6
<i>Elimia</i>	2.5	1.2	15.9	0.7	0.1	5.9	3.0
<i>Simulium</i>	4.4	2.9	8.4	1.7	1.5	0.1	0.5
<i>Rheotanytarsus</i>	6.4	5.9	7.8	2.2	0.8	0.2	0.9
<i>Crangonyx</i>	8.0	2.1	1.8	7.6	0.4	8.2	5.8
Planariidae	7.5	3.9	0.7	7.6	2.9	--	3.6
<i>Stenacron</i>	7.1	2.0	1.4	7.3	4.1	2.2	5.9
<i>Lirceus</i>	7.7	5.6	1.6	4.8	--	0.4	0.4
<i>Psephenus herricki</i>	2.5	0.1	0.8	0.4	11.8	--	0.2
<i>Caenis latipennis</i>	7.6	0.5	1.0	0.2	8.7	11.5	4.2
Tubificidae	9.2	3.1	0.6	2.7	7.5	--	5.8
<i>Chimarra</i>	2.8	0.5	0.3	4.2	7.0	0.1	1.8
Leptophlebiidae	2.0	0.3	0.1	0.3	1.5	2.7	10.3

Values in bold type represent the five dominant macroinvertebrate taxa for each station.

Table 17

Percent EPT, Dominant Macroinvertebrate Families and Macroinvertebrate Taxa at Pearson Creek Test Stations, Spring 2005, 2013, and 2015

Variable-Station	Biotic Index	Pearson Creek #1			Pearson Creek #2		Pearson Creek #3	Pearson Creek #4	
Sample Number		0503034	PEARS1_S13	15105	0503032	0503033	15106	PEARS3_S13	15107
Sample Date		03/24/05	04/15/13	03/25/15	03/22/05	03/22/05	03/25/15	04/15/13	03/25/15
EPT Metrics									
% EPT		8.1	2.7	12.2	3.2	3.4	21.1	18.3	17.9
% Ephemeroptera		7.0	1.6	8.3	2.0	2.3	8.6	15.1	11.1
% Plecoptera		0.1	--	--	0.3	0.1	3.3	0.2	3.6
% Trichoptera		0.9	1.1	3.9	0.8	0.9	9.2	3.0	3.2
Percent Dominant Families									
Chironomidae		59.9	46.4	45.5	73.6	75.4	63.7	50.4	52.8
Asellidae		10.6	1.6	7.7	9.7	6.6	--	0.5	0.8
Elmidae		7.2	25.7	13.3	1.8	1.8	2.5	2.2	8.9
Baetidae		6.3	1.3	5.8	1.4	1.2	1.8	4.6	4.2
Planariidae		3.1	--	4.6	1.4	0.9	2.0	--	2.9
Pleuroceridae		0.4	16.6	0.5	0.1	0.1	1.2	0.5	0.5
Crangonyctidae		1.8	3.8	6.6	4.3	4.7	0.2	16.1	7.5
Simuliidae		1.3	0.4	0.7	1.5	1.6	0.2	0.4	0.1
Heptageniidae		0.4	--	2.3	0.1	0.1	3.9	2.2	3.8
Hydroptilidae		0.5	0.6	0.3	0.3	0.8	3.2	2.4	0.1
Leuctridae		--	--	--	--	--	3.1	--	3.4
Tubificidae		1.7	--	4.4	0.5	1.2	2.8	--	2.3
Caenidae		0.3	0.3	--	0.5	1.0	2.5	7.0	1.2
Arachnida		1.5	0.7	1.9	0.6	0.3	2.1	4.9	2.3
Percent Dominant Taxa									
<i>Cricotopus/Orthocladus</i> grp.	6.5	17.9	22.0	5.4	25.1	25.4	3.8	11.9	9.7
<i>Lirceus</i>	7.7	10.7	1.6	7.5	9.6	6.6	--	0.5	0.2
<i>Eukiefferiella</i>	4.0	9.8	5.1	8.3	7.7	8.7	9.5	0.6	2.3
<i>Paratendipes</i>	5.3	6.7	4.7	7.5	2.4	1.3	14.4	7.7	6.0
<i>Optioservus sandersoni</i>	2.7	6.6	23.2	10.9	1.2	1.2	1.0	0.9	6.9
<i>Elimia</i>	2.5	0.4	16.6	0.5	--	0.1	1.0	0.6	0.5
<i>Polypedilum flavum</i>	5.3	1.3	6.8	0.6	0.9	1.4	1.2	0.5	0.1
<i>Crangonyx</i>	8.0	1.8	3.8	6.4	4.3	4.8	0.2	16.1	7.5
<i>Dicrotendipes</i>	7.9	3.3	2.0	0.5	27.1	24.6	--	0.3	0.1
<i>Micropsectra</i>	1.4	1.2	0.7	5.5	1.5	0.8	8.6	8.8	9.1
<i>Rheocricotopus</i>	7.3	0.1	--	0.1	--	--	6.8	0.1	0.5
<i>Stempellinella</i>	5.3	0.6	--	1.4	0.5	0.5	4.0	0.1	1.0
<i>Caenis latipennis</i>	7.6	0.3	0.3	--	0.5	1.0	2.5	7.0	1.2
<i>Thienemannimyia</i> grp.	6.0	0.4	0.1	1.9	1.4	1.2	1.8	1.3	6.6

Values in bold type represent the five dominant macroinvertebrate taxa for each station.

Historical macroinvertebrate data on Pearson Creek collected by City Utilities of Springfield and the Missouri Clean Water Commission found that many of the EPTT that were present at Pearson Creek stations downstream of Jones Branch (lower Pearson Creek) in the 1964-65 samples were not present in samples collected from 1984 to 1992 (Table 18). Mayfly taxa *Caenis*, *Centroptilum*, *Choroterpes*, *Ephemera*, *Leucrocuta*, *Isonychia*, *Leptophlebia*, *Paraleptophlebia*, and *Plauditis* were found in the 1964-65 samples but were not found in the 1984-92 samples. There may have been some heptageniid mayflies that were in the 1964-65 samples that were not present in 1984-92, but it is unknown since the level of taxonomic identification was different for the two time periods. Heptageniid mayflies *Stenonema mediopunctatum*, *S. pulchellum*, and *S. terminatum* (now known as *Maccaffertium* species) were found in the 1964-65 samples but *Stenonema* species mayflies were only identified to *Stenonema pulchellum* grp. in the 1984-92 samples as described in U.S. EPA (1974). Mayfly taxa that were found during both sampling periods at the lower Pearson Creek sampling stations were *Stenonema pulchellum* grp., *Stenonema femoratum*, *Stenacron*, and *Baetis*. It should be noted that some of *Baetis* species mayflies found during both time periods were probably *Dipheter hageni*. This species was previously called *Baetis hageni*, and it was found in Pearson Creek as part of a survey Pearson Creek mayflies during the 1970's (Witte 1983). *Dipheter* was also common in most of the Pearson Creek #1 samples collected by MoDNR and U.S. EPA from 2004 to 2015. Other mayfly taxa that were found by Witte (1983) that were not found in the historical samples from the 1964-65 and 1984-92 in lower Pearson Creek were *Neochoroterpes*, *Habrophleboides*, *Ephemerella*, and *Eurylophella*. Many of the taxa found in 1964-65 samples and the Witte (1983) study that were not found in the 1984-92 samples were also absent in the MoDNR and U.S. EPA lower Pearson Creek samples collected from 2004 to 2015. The only exceptions were *Caenis*, *Isonychia*, *Leptophlebia*, and *Paraleptophlebia*. *Isonychia* was not found in most of the MoDNR and U.S. EPA samples, but one specimen of *Isonychia bicolor* was collected at Pearson Creek #1 during the spring 2015 sampling season.

Many of the mayfly taxa that were not present in the 1984-92 samples at the Lower Pearson Creek stations were present at sampling stations upstream of Jones Branch (upper Pearson Creek). These upper Pearson Creek sampling stations included reaches at or near Pearson Creek #3 and #4 for this study. Taxa that were found at both the upper Pearson Creek in 1984-92 and lower Pearson Creek stations in 1964-65 but not at the lower Pearson Creek stations in 1984-92 were *Leucrocuta*, *Leptophlebia*, *Paraleptophlebia*, and *Plauditis*. In addition to these taxa, *Ephemerella* was found at Pearson Creek #4 and another station upstream of station #4 during the 1984-92 time period. Many of the mayfly taxa found in the historical samples from 1964-65 and 1984-92 also were found in the MoDNR and U.S. EPA upper Pearson Creek samples collected from 2004 to 2015, but a few taxa either were rare or absent. One *Centroptilum* specimen was found in the spring 2013 sample at Pearson Creek #4, and one *Choroterpes* specimen was found at Pearson Creek #3 in the fall 2014 sample, but these taxa were not found in any of the other MoDNR or U.S. EPA samples. The heptageniid mayfly *Leucrocuta* and the baetid mayfly *Plauditis* were not found in any of the upper Pearson Creek sampling stations in any of the MoDNR or U.S. EPA samples.

Table 18
Presence or Absence of EPTT found at Pearson Creek from Samples Collected by Missouri
Clean Water Commission in 1964-65 and City Utilities of Springfield 1984-1992.

Variable-Station	Pearson Creek #1		Lower Pearson Creek Multiple Stations	Pearson Creek #3	Pearson Creek #4	Upper Pearson Creek Multiple Stations
Sampling Period	1964-65	1984-92	1984-92	1984-92	1984-92	1984-92
Number of Sampling Stations	1	1	3	1	1	5
Ephemeroptera						
<i>Baetis</i>	P	P	P	P	P	P
<i>Centroptilum</i>	P	--	--	--	--	--
<i>Plautiditis</i>	P	--	--	P	P	P
<i>Caenis</i>	P	--	--	P	P	P
<i>Ephemerella</i>	--	--	--	--	P	P
<i>Ephemerella</i>	P	--	--	--	--	--
<i>Leucrocota</i>	P	--	--	P	--	P
<i>Stenacron</i>	P	P	P	P	P	P
<i>Stenonema femoratum</i>	P	--	P	P	--	P
<i>Stenonema pulchellum</i> grp.	--	P	P	P	--	P
<i>Maccaffertium mediopunctatum</i>	P	--	--	--	--	--
<i>Maccaffertium pulchellum</i>	P	--	--	--	--	--
<i>Maccaffertium terminatum</i>	P	--	--	--	--	--
<i>Isonychia</i>	P	--	--	--	--	--
<i>Choroterpes</i>	P	--	--	--	--	--
<i>Leptophlebia</i>	P	--	--	--	P	P
<i>Paraleptophlebia</i>	P	--	--	P	P	P
Plecoptera						
Capniidae	--	--	--	P	P	P
Chloroperlidae	--	P	P	--	P	P
Leuctridae	--	--	--	P	P	P
Nemouridae	P	--	--	P	P	P
<i>Acroneuria</i>	P	P	P	P	P	P
<i>Agneta capitata</i>	P	--	--	--	--	--
<i>Neoperla</i>	P	--	--	P	--	P
<i>Perlesta</i>	P	P	P	P	P	P
<i>Isoperla</i>	P	P	P	--	P	P
<i>Strophopteryx fasciata</i>	P	--	--	--	--	--
Trichoptera						
<i>Agapetus</i>	P	--	--	P	P	P
<i>Helicopsyche</i>	P	--	--	P	P	P
<i>Cheumatopsyche</i>	P	P	P	P	P	P
<i>Hydropsyche</i>	P	--	P	P	P	P
Hydroptilidae	P	P	P	P	P	P
<i>Chimarra</i>	P	P	P	P	P	P
Polycentropidae	--	--	--	P	P	P
Psychomyiidae	--	P	P	--	P	P
Rhyacophilidae	--	--	--	P	--	P
<i>Neophylax</i>	--	--	--	P	--	P

P indicates that taxon was present

Seven stonefly taxa or taxa groups were found in the 1964-65 samples and four were found in 1984-1992 samples at Pearson Creek #1 (Table 18). The six stonefly taxa from the 1964-65 samples were *Acroneuria*, *Perlesta*, *Isoperla*, *Agnetina capitata*, *Neoperla*, Nemouridae, and *Strophophteryx fasciata*. Stonefly taxa found in the 1984-1992 samples were *Acroneuria*, *Perlesta*, *Isoperla*, and Chloroperlidae. Seven stonefly taxa were found in 1984-92 upper Pearson Creek samples. In addition to the four stonefly taxa found at Pearson Creek #1, Leuctridae, Nemouridae, *Neoperla*, and Capniidae also were found at upper Pearson Creek stations. Stonefly diversity was much higher in both historical data sets compared to MoDNR and U.S. EPA data collected from 2004 to 2015 at Pearson Creek #1. Except for one *Perlesta* specimen collected during the spring 2005 sampling season, stonefly taxa were absent at test station #1. Six stonefly taxa were found in the MoDNR and U.S. EPA samples collected from 2013 to 2015 at Pearson Creek #3 and #4. Taxa found in these samples were *Acroneuria*, *Clioperla clio*, *Perlesta*, *Isoperla*, *Amphinemura*, and Leuctridae. Leuctrid stoneflies collected at Pearson Creek #3 and #4 during the spring 2015 sampling season were the only relatively abundant stonefly group in MoDNR and U.S. EPA samples.

Many of the Trichoptera taxa that occurred in the 1964-65 samples were also found in the 1984-92 samples at the lower Pearson Creek sampling stations, including Pearson Creek #1 (Table 18). The only differences in taxa occurrence was that *Helicopsyche* was only found in the 1964-65 samples and Psychomiidae was only found in the 1984-1992 samples. *Helicopsyche* was found in the 2014-2015 MoDNR samples at test stations #3 and #4, but not at test station #1. Psychomiidae was found in the 2014-2015 MoDNR samples at test stations #1 and #3. Data from 1984-92 from the upper Pearson Creek sampling stations showed that Trichoptera TR was higher than the lower Pearson Creek sampling stations during both sampling periods. Taxa that occurred at one or more of the upper Pearson Creek sampling stations but not at the lower Pearson Creek sampling stations in 1984-92 were *Agapetus*, *Helicopsyche*, *Hydropsyche*, Polycentropidae, Rhyacophilidae, and *Neophylax*. Data from MoDNR and U.S. EPA samples collected from 2004 to 2015 showed similar results to the historical data with higher Trichoptera TR at the upper Pearson Creek sampling stations. All of the taxa that were found in 1984-92 lower Pearson Creek samples also were found in the MoDNR and U.S. EPA samples collected from 2004 to 2015. In addition to these taxa, *Polycentropus*, *Triaenodes*, Glossosomatidae (one specimen from spring 2015 sample), and *Pycnopsyche* were found at the lower Pearson Creek sampling stations (test stations #1 and #2). Most caddisfly taxa that were found in the 1984-92 upper Pearson Creek samples also were found in the U.S. EPA 2013 samples and the 2014-2015 MoDNR samples. The only exceptions were the absence of *Agapetus* and *Hydropsyche* at test station #3 and *Neophylax* at test station #4. In addition to these taxa, *Oecetis*, *Triaenodes*, and *Pycnopsyche* were found at test station #3. At test station #4 *Triaenodes*, *Pycnopsyche*, and *Lype diversa* (one specimen from spring 2013 sample) also were found in the 2013-2015 samples.

4.2 Physicochemical Data

4.2.1 Water

Table 19 compares water chemistry analysis results from the current study to results from the 2004-2005 study. Some of the analyses (sulfate, hardness, and dissolved metals) that were collected in 2014-2015, but not in 2004-2005, are not included in the table. A comparison of water quality data from the MoDNR 2004-2005 study and the current study showed elevated

nitrogen concentrations during both sampling periods (Table 19). Total phosphorus was elevated for all of the fall samples, but it was only elevated in the spring during the 2004-2005 study. Total Kjeldahl Nitrogen (TKN) was higher in the 2004-2005 study than the U.S. EPA recommended concentrations of 0.05 mg/L (U.S. EPA 2000) during the fall sampling season, but not for the spring sampling season. Turbidity was also elevated at all sampling stations except Pearson Creek #4 during both sampling periods. No comparison between studies was made for TKN and total nitrogen because TKN was not collected in the current study, and total nitrogen was not collected in 2004-2005.

Table 20 shows the results of water samples collected by the U.S. EPA (unpublished data) from April-September 2013 and April-October 2014. All of the values in the table were based on data from both sampling years except chloride, which was only analyzed for 2014 water samples. Like the MoDNR water sample results, these U.S. EPA samples showed elevated levels for total nitrogen, total phosphorus, and turbidity. For total nitrogen, the mean $\pm$ SD value was 2.41 ± 0.25 mg/L at Pearson Creek #1, 2.67 ± 0.26 mg/L at Jones Branch, and 1.95 ± 0.41 mg/L at Pearson Creek #4. For total phosphorus, mean $\pm$ SD values were calculated by assigning a value of half of the detection limit (0.005 mg/L) for results that were below the detectable limit of 0.01 mg/L. All samples had phosphorus values above laboratory detection limits with the exception of a single sample each at Pearson Creek #1 and #4 and three samples from Jones Branch. Total phosphorus mean $\pm$ SD values were 0.03 ± 0.01 mg/L at Pearson Creek #1, 0.02 ± 0.01 mg/L at Jones Branch, and 0.03 ± 0.02 mg/L at Pearson Creek #4. Most turbidity samples were higher than the U.S. EPA recommended reference value of 1.43 NTU for the Ozarks. There were no turbidity readings below this recommended value at Pearson Creek #1, two values at Jones Branch, and three values at Pearson Creek #4. Turbidity mean $\pm$ SD values were 3.33 ± 1.86 NTU at Pearson Creek #1, 3.29 ± 2.14 NTU at Jones Branch, and 2.27 ± 1.39 NTU at Pearson Creek #4.

4.2.2 Sediment

Because sediment analysis was not included as part of the 2004-2005 MoDNR study, no comparisons with the current study can be made regarding metals and PAH analysis. Sediment samples, however, were collected by U.S. EPA (unpublished data) in 2013 and 2014 at Pearson Creek and Jones Branch (Table 21). The U.S. EPA collected sediment samples on six dates between April and September 2013 and three dates in 2014 (April, July, and September). Both the 2014-2015 MoDNR data and the U.S. EPA data showed elevated levels of cadmium, lead, and zinc, but some of the U.S. EPA samples had much higher concentrations of these metals at Jones Branch. U.S. EPA samples showed that Pearson Creek #1 and Jones Branch generally had higher concentrations of cadmium, lead, and zinc than station #4. Exceptions to this trend are noted in the July 15, 2014 Pearson Creek #4 sample, which showed high concentrations of cadmium (4.7 $\mu\text{g/kg}$), lead (169 $\mu\text{g/kg}$), and zinc (820 $\mu\text{g/kg}$). The lead and zinc values for this sample were above the PEC, and the cadmium value was slightly below the PEC. Results for this sample date are highly atypical, however, and do not follow the overall trends of these sites compared to the other U.S. EPA samples and MoDNR samples.

Table 19
Physicochemical Parameters from Water Samples collected at Pearson Creek Bioassessment
Study Sampling Stations, 2004-2005 and 2014-2015 Sampling Seasons

	Pearson Creek #1		Pearson Creek #2		Pearson Creek #3	Pearson Creek #4
Fall Sampling Season						
Invertebrate Sample Number	0449877	14942			14941	14940
Physicochemical Sample Number	0411071	1411953			1411952	1411951
Sample Date	09/29/04	09/23/14			09/23/14	09/23/14
Sample Time	1535	1515			1100	1310
Ammonia	<0.03 ^a	<0.03 ^a			<0.03 ^a	<0.03 ^a
Chloride	25.5	20.8			15.1	16.6
Dissolved Oxygen	10.4	9.80			9.50	9.78
Discharge (cfs)	2.17	9.62			4.36	3.83
pH (Units)	7.8	7.9			8.3	8.2
Conductivity (µmhos/cm)	488	495			434	430
Temperature (°C)	18.5	18.4			15.3	15.8
Turbidity (NTU)	2.62	2.10			1.56	1.06
Total Suspended Solids		<5 ^a			<5 ^a	<5 ^a
Nitrate + Nitrite-N	1.32	2.49 ^c			1.79	1.92
TKN	0.13 ^b					
Total Nitrogen		2.29			1.67	1.83
Total Phosphorus	0.05 ^b	0.04			0.04	0.04
Spring Sampling Season						
Invertebrate Sample Number	0503034	15105	0503032	0503033	15106	15107
Physicochemical Sample Number	0502874	151841	0502872	0502873	151842	151843
Sample Date	03/24/05	03/25/15	03/22/05	03/22/05	03/25/15	03/25/15
Sample Time	1110	1025	1340	1340	1135	1245
Ammonia	<0.03 ^a	<0.03 ^a	<0.03 ^a	<0.03 ^a	<0.03 ^a	<0.03 ^a
Chloride	16.5	23.9	20.8	19.8	14.4	15.7
Dissolved Oxygen	11.3	10.99	12.3	11.5	12.18	11.75
Discharge (cfs)	39.50	26.55	8.72	8.72	14.42	12.15
pH (Units)	7.8	7.9	8.0	7.9	7.9	8.0
Conductivity (µmhos/cm)	424	456	470	458	382	378
Temperature (°C)	11.0	13.0	12.1	12.0	12.7	13.8
Turbidity (NTU)	5.10	2.50	11.5	4.80	1.85	1.43
Total Suspended Solids		<5 ^a			<5 ^a	<5 ^a
Nitrate + Nitrite-N	2.52	2.37 ^c	2.54	2.53	1.72	1.78
TKN	<0.05 ^a		<0.05 ^a	<0.05 ^a		
Total Nitrogen		2.35			1.73	1.78
Total Phosphorus	0.02 ^b	<0.01 ^a	0.02 ^b	0.03 ^b	<0.01 ^a	<0.01 ^a

^aBelow detectable limits

^bEstimated value, detected below Practical Quantitation Limit

^cSample diluted during analysis

Units mg/L unless otherwise noted. Values in bold are elevated compared to water quality standards or U.S. EPA recommended reference condition values.

Table 20
Range of Values for Physicochemical Water Sample Parameters Collected by the U.S. EPA at
Pearson Creek Bioassessment Study Sampling Stations, April 2013 to October 2014

	Pearson Creek #1	Jones Branch	Pearson Creek #4
Chloride	15.9 - 32.6	30.0 – 49.2	9.4 – 26.0
Calcium	78.0 – 92.1	78.2 – 110	62.8 – 83.6
Magnesium	4.01 – 6.04	2.21 – 3.33	4.20 – 7.48
Dissolved Hardness as CaCO ₃	87.9 – 255	111 – 288	74.1 – 240
Dissolved Oxygen	8.14 – 10.40	8.41 – 11.60	8.97 – 11.70
Discharge (cfs)	4.4 – 43.0	--	--
pH (Units)	7.5 – 8.2	7.8 – 8.2	7.7 – 8.3
Conductivity (µmhos/cm)	341 – 469	377 – 541	282 – 412
Temperature (°C)	10.2 – 19.9	11.9 – 22.1	9.2 – 18.8
Turbidity (NTU)	1.5 – 9.0	1.0 – 5.7	0.1 – 5.6
Total Suspended Solids	<4.0 – 12.7	<4 – 8.9	<4 – 13.2
Total Nitrogen	1.99 – 2.68	2.34 – 3.13	1.47 – 3.17
Total Phosphorus	<0.01 – 0.05	<0.01 – 0.05	<0.01 – 0.08
Dissolved Arsenic (µg/L)	Non-detect	Non-detect	Non-detect
Dissolved Barium (µg/L)	65 – 132	66 – 135	60.2 – 128
Dissolved Cadmium (µg/L)	Non-detect	Non-detect	Non-detect
Dissolved Chromium (µg/L)	<2 – 8.2	<2 – 8.6	<2 – 7.2
Dissolved Cobalt (µg/L)	Non-detect	Non-detect	Non-detect
Dissolved Copper (µg/L)	Non-detect	<2 – 2.4	<2 - 4.2
Dissolved Lead (µg/L)	Non-detect	Non-detect	Non-detect
Dissolved Manganese (µg/L)	5.0 – 34.6	8.0 – 68.0	5.0 – 19.1
Dissolved Nickel (µg/L)	<1 – 2.9	1.3 – 3.9	<1 – 5.2
Dissolved Selenium (µg/L)	Non-detect	Non-detect	Non-detect
Dissolved Thallium (µg/L)	Non-detect	Non-detect	Non-detect
Dissolved Zinc (µg/L)	<2 – 29.0	<2 – 27.0	<2 – 26.8

Units mg/L unless otherwise noted. Values in bold exceed Missouri Water Quality Standards or are elevated compared to U.S. EPA recommended reference condition values.

Sample size for all constituents except chloride and discharge was 16 at Pearson Creek #1, 15 at Jones Branch, and 14 at Pearson Creek #4. For chloride, sample size was 9 at Pearson Creek #1, 8 at Jones Branch, and 7 at Pearson Creek #4. Discharge sample size was 15 and based on data collected from USGS gaging station 07050690 located at Pearson Creek #1.

Table 21

Range of Values for Physicochemical Sediment Sample Parameters Collected by the U.S. EPA at Pearson Creek Bioassessment Study Sampling Stations, April 2013 to September 2014

Variable-Station	Pearson Creek #1	Jones Branch	Pearson Creek #4	PEC Value
Metals (mg/kg)				
Arsenic	<8.4 - <16.0	<7.1 – 10.8	<7.7 - <13.2	33.0
Barium	62.9 – 1.37	63.2 – 96.4	72.7 - 119	*
Cadmium	<1.7 - <3.2	<1.5 – 9.5	<1.5 - <4.7	4.98
Chromium	10.7 – 22.2	10.5 – 16.6	12.8 – 21.0	111
Cobalt	5.4 – 12.6	5.7 – 8.5	5.8 – 10.0	*
Copper	7.3 – 13.2	6.3 – 12.0	7.0 – 14.0	149
Lead	23.4 – 63.9	86.9 – 443	10.5 – 169	128
Manganese	277 – 1020	294 – 1180	376 – 1340	*
Nickel	7.2 – 13.0	7.1 – 12.4	7.5 – 13.2	48.6
Selenium	<16.9 - <31.9	<14.2 - <15.9	<15.4 - <26.4	*
Thallium	<16.9 - <31.9	<14.2 - <15.9	<15.4 - <26.4	*
Zinc	100 – 379	369 - 1140	41.7 – 820	459
PAHs (µg/kg)				
Anthracene	<120 - <640	<97 - <290	<120 - <490	845
Benz[a]anthracene	<120 - <640	<97 - <290	<120 - <490	1050
Benzo(a)pyrene	<120 - <640	<97 - <290	<120 - <490	1450
Chrysene	<120 - <640	<97 - <290	<120 - <490	1290
Fluorene	<120 - <640	<97 - <290	<120 - <490	536
Fluoranthene	<120 - <640	<97 - <290	<120 - <490	2230
Naphthalene	<120 - <640	<97 - <290	<120 - <490	561
Phenanthrene	<120 - <640	<97 - <290	<120 - <490	1170
Pyrene	<120 - <640	<97 - <290	<120 - <490	1520
Organochlorine Pesticides (µg/kg)				
Chlordane	26 – 61	34 - 66	<18 - <19	17.6

Values in bold exceed PEC values.

Samples size for all constituents except chlordane was 11 at Pearson Creek #1, 9 at Jones Branch, and 10 at Pearson Creek #4. Sample size for chlordane was 2.

* No PEC values available.

Jones Branch cadmium mean $\pm$ SD values were calculated by assigning a value of half of the detection limit (0.75 µg/kg) for results that were below the detectable limit of 1.5 µg/kg. All Jones Branch cadmium concentrations were above the detection limit except the sample collected on July 15, 2014. Jones Branch had a mean $\pm$ SD for cadmium of 3.9 ± 2.9 µg/kg, and three of the samples (May, June, and July of 2013) had values above the PEC value. Cadmium levels were below detectable limits at Pearson Creek #1 for all of the U.S. EPA sediment samples. Cadmium concentrations also were below detectable limits for all Pearson Creek #4 U.S. EPA samples except for the July 15, 2014, sample.

Lead mean $\pm$ SD values from the U.S. EPA samples were 38.2 ± 12.5 $\mu\text{g/kg}$ at Pearson Creek #1, 154.6 ± 123.6 $\mu\text{g/kg}$ at Jones Branch, and 30.6 ± 48.7 $\mu\text{g/kg}$ at Pearson Creek #4. Except for the previously mentioned July 15, 2014, samples, lead levels found in the U.S. EPA samples were fairly similar to Pearson Creek #1 and #4, but they were much higher at Jones Branch compared to the MoDNR 2014-2015 data. Three of the Jones Branch U.S. EPA samples (May, June, and July of 2013) were above the PEC value for lead.

Zinc mean $\pm$ SD values from the U.S. EPA samples were 208.1 ± 83.5 $\mu\text{g/kg}$ at Pearson Creek #1, 513.6 ± 297.9 $\mu\text{g/kg}$ at Jones Branch, and 136.5 ± 240.3 $\mu\text{g/kg}$ at Pearson Creek #4. Three of the Jones Branch U.S. EPA samples (May, June, and July of 2013) were above the PEC value for zinc. Except for the previously mentioned July 15, 2014 samples, zinc values collected at Pearson Creek #1 during the MoDNR 2014-2015 study, fell within the range of values collected by U.S. EPA, but the zinc value collected at Pearson Creek #4 during the spring 2015 sampling season was higher than the U.S. EPA values. With the exception of two samples, all of the Jones Branch zinc values from U.S. EPA samples were higher than those collected during the 2014-2015 MoDNR study. The exceptions included the samples collected on September 17, 2013, (369 $\mu\text{g/kg}$) and July 15, 2014 (41.7 $\mu\text{g/kg}$). Four of the nine U.S. EPA samples were above the PEC value for zinc.

U.S. EPA sediment samples collected on April 15 and September 17, 2013, were analyzed for organochlorine pesticides. Chlordane concentrations were higher than the PEC value at Pearson Creek #1 and Jones Branch in both samples. Chlordane was below detectable limits at Pearson Creek #4. It should be noted, however, that laboratory detection limits for chlordane are above the PEC value.

5.0 Discussion

The discussion section describes stream habitat conditions, land use, hydrology, biological metrics, macroinvertebrate community composition, data trends, and possible water quality and sediment quality impacts on the macroinvertebrate community.

5.1 Habitat Assessment

Results of the stream habitat assessment during the fall 2014 sampling season are based on total habitat scores, which suggest that the Pearson Creek test stations should be comparable to North Fork of the White River, a biological criteria reference stream, in their ability to support a similar quality macroinvertebrate community. Although the overall habitat scores were good, some of the stream habitat parameters of the SHAPP indicated that habitat might be affecting the macroinvertebrate community. At Pearson Creek #1, channel flow status, riffle quality, right bank stability, and vegetative protection of both banks scored in the marginal or poor categories. Stream parameters scoring in the marginal or poor category at Pearson Creek #3 were epifaunal substrate, channel flow status, riffle quality, right bank stability, and vegetative protection of both banks. At Pearson Creek #4, stream categories that scored in the marginal or poor range were riffle quality, vegetative protection for both banks, and riparian zone width for both banks. All of the stream parameters that scored in the marginal or poor categories can affect macroinvertebrate community, but parameters that measure substrate quality such as epifaunal

substrate, sediment deposition, and riffle quality tend to have more of a direct effect since macroinvertebrates reside on the stream bottom and interstitial spaces of gravel substrate.

5.2 Hydrology and Land Use

Land use upstream of Pearson Creek #4 is primarily rural with grassland being the dominant land use. Urban land use types increase in the lower part of the watershed with the low intensity urban category increasing dramatically at Pearson Creek #1. Percent forest for the Pearson Creek watershed is much lower than the entire Ozark/White EDU. The Springfield metropolitan area has dramatically increased in population in recent years (Missouri Census Data Center website at <http://mcdc.missouri.edu>), which has led to more development in the Pearson Creek watershed. The increased amount of impervious surfaces caused by development has likely altered the hydrology of Pearson Creek and increased runoff (Lazaro 1990; Paul and Meyer 2001). Using USGS stream gage data, the U.S. EPA calculated flow duration curves for Pearson Creek and synthetic reference flows for the Ozark/White EDU biological criteria reference streams, which found that Pearson Creek had lower flows during low flow periods and higher flows during high flow events (U.S. EPA 2011). These results indicate that increased urbanization of the Pearson Creek watershed has altered its hydrology. Increased runoff during high flow events likely carries more contaminants, such as petroleum products, fertilizer, and pesticides that could lead to water quality problems, which could then affect the macroinvertebrate community.

5.3 Biological Metrics and Macroinvertebrate Community Composition

The macroinvertebrate samples collected from Pearson Creek during the fall 2014 and spring 2015 sampling seasons scored poorly for most of the biological metrics making up the MSCI (Table 4). The SDI was the only metric that generally scored well. All but the fall 2014 Pearson Creek #1 sample had SDI values in the fully supporting category (score of 5). The EPTT metric tended to perform the poorest at Pearson Creek #1, with values on the borderline between the partially supporting (Score of 3) and non-supporting (Score of 1).

Pearson Creek samples were generally made up of more tolerant taxa with a higher percentage of samples having taxa with biotic index values ≥ 5 compared to reference conditions during both sampling seasons (Tables 5 and 7). The proportion of EPTT and mayflies during both sampling seasons was lower than reference conditions (Tables 6 and 8). Stoneflies were not collected at Pearson Creek #1 during either sampling season, but they were found at the other two test stations in similar or slightly lower abundance compared to reference conditions. Many of the most common EPTT taxa found in Pearson Creek were generally more tolerant than the most common EPTT found in the biological criteria reference streams. There were, however, sensitive EPTT such as *Diphetor* and *Chimarra* that were common in some of the Pearson Creek samples. During the fall 2014 sampling season, more tolerant EPTT such as *Stenacron*, *Caenis latipennis*, and *Cheumatopsyche* were more common in Pearson Creek, whereas more sensitive EPTT taxa such as *Maccaffertium mediopunctatum* and *Isonychia bicolor* were more common in biological criteria reference streams. During the spring 2015 sampling season, chironomids dominated the Pearson Creek samples, but more sensitive taxa like *Elimia*, *Leucrocuta*, and *Ephemerella invaria* were more abundant in the biological criteria reference streams. Two of those taxa, *Leucrocuta* and *Ephemerella invaria*, did not occur in Pearson Creek samples.

The FFG scrapers were lower in abundance and gatherer-collectors were higher in the Pearson Creek samples compared to reference conditions. Scrapers included macroinvertebrates such as heptageniid mayflies, water pennies, elmids beetles, and snails that generally feed on periphyton made up primarily of diatoms that grow on the bottom substrates of streams. Scrapers are sensitive to increased sedimentation and usually are lower in abundance in stream reaches that have lower amounts of hard substrate and higher amounts of fine sediment (Rabeni et al. 2005). Gatherer-collectors were the most abundant FFG in the Pearson Creek samples, and Rabeni et al. (2005) found that both shredders and gatherer-collectors are tolerant of sediment deposition. Results of the habitat assessment did not indicate that sediment deposition was a major problem at Pearson Creek since all three stations scored in the suboptimal category, but field observations during sampling indicated that a fine layer of sediment at many locations was present at Pearson Creek #4, and larger pockets of sediment were present at the other two sampling stations.

5.4 Macroinvertebrate Community Composition Data Trends

Macroinvertebrate data collected by City Utilities of Springfield (Youngsteadt 1995) from 1984 to 1992 found that EPTT were much more abundant in Pearson Creek upstream of Jones Branch (Table 15). Results from this current study found a similar trend, especially during the spring 2015 sampling season, which found a higher number of EPTT taxa among samples upstream of Jones Branch. Samples collected in 1992 by City Utilities of Springfield also showed that TR and EPTT had declined substantially in Pearson Creek downstream of Jones Branch compared to samples collected in 1964 and 1965 (Table 14).

Mayfly taxa *Isonychia bicolor*, *Leucrocuta*, *Neochoroterpes*, *Habrophleboides*, *Paraleptophlebia*, *Ephemerella*, *Eurylophella*, and *Ephemera* were collected in Pearson Creek downstream Jones Branch in the 1970s (Witte 1983). These mayflies either were not present or were found in low numbers in the MoDNR samples. One *Eurylophella bicolor* specimen was collected at Pearson Creek #4, one *Isonychia bicolor* specimen was collected at Pearson Creek #1, and three *Paraleptophlebia* specimens were collected at Pearson Creek #4 during the spring 2015 sampling season. The remaining mayfly taxa found by Witte (1983) were not found in the MoDNR Pearson Creek macroinvertebrate samples. *Paraleptophlebia* was found in the City Utilities of Springfield samples collected from 1984-92 at the upper Pearson Creek sampling stations, but not at the lower Pearson Creek sampling stations (Table 18).

Stoneflies declined dramatically in the MoDNR and U.S. EPA samples in lower Pearson Creek compared to historical data (Tables 6, 8, and 14). Four stonefly taxa (Chloroperlidae, *Acroneuria*, *Perlesta*, and *Isoperla*) occurred at Pearson Creek #1 in the historical samples collected from 1984-92, but stoneflies were not collected in most of the MoDNR and U.S. EPA samples. The only exception was that one *Perlesta* specimen was collected during the spring 2005 sampling season at Pearson Creek #1. Stonefly TR for MoDNR and U.S. EPA samples for upper Pearson Creek (test stations #3 and #4) was higher and more comparable to historical data collected from 1984-92. Six stonefly taxa (*Acroneuria*, *Clioperla clio*, *Perlesta*, *Isoperla*, *Amphinemura*, and Leuctridae) were found in the more recent samples from upper Pearson Creek compared to eight taxa found in 1984-92 historical samples. Taxa that occurred in the historical

samples at upper Pearson Creek but not in recent samples were Capniidae, Chloroperlidae, and *Neoperla*.

5.5 Possible Water Quality and Sediment Quality Impacts

The reduction of EPTT and lack of some EPT taxa that are found in the biological criteria streams or were once found in Pearson Creek indicates that contaminants documented as being present in the Pearson Creek watershed may be affecting the macroinvertebrate community. Although water samples collected during this study had elevated levels of nitrate + nitrite-N, this alone would likely not account for the low EPTT values, especially at Pearson Creek #1. Jones Branch has been hypothesized as a possible source of contamination, and the sediment sample collected during the spring 2005 sampling season indicated low levels of toxicity for the acute EC20 test. A chronic toxicity test was not performed, but based on the acute EC20 test, chronic toxicity is possible.

Historic mining that was part of the tri-state mining area took place in the Pearson Creek watershed from 1885 to 1920 (Thomson 1986). There were about 40 mines and prospecting locations with some of the sites near Jones Branch and Pearson Creek #1, but the highest density of sites were located downstream of Pearson Creek #1 (Figure 2). A MoDNR sediment sample collected on August 23, 1999, in Jones Branch just downstream of Jones Spring showed elevated levels of aluminum, cadmium, iron, lead, zinc, mercury, and the pesticide chlordane. Sediment samples were collected as part of this study and by U.S. EPA in 2013 and 2014. Both MoDNR and U.S. EPA found that cadmium, lead, and zinc were higher in some Jones Branch and Pearson Creek #1 samples compared to the upstream Pearson Creek stations. None of the values for metals were above PEC values in this study, but some of U.S. EPA samples from Jones Branch were above PEC values.

U.S. EPA sediment samples collected in April and September of 2013 found that the pesticide chlordane was above PEC values at Pearson Creek #1 and Jones Branch. A MoDNR sediment sample collected from Jones Branch in 1999 also found that chlordane was above PEC concentrations. A study by USGS of the Pearson Creek watershed found low levels of the pesticide diazinon and slightly elevated levels of zinc and aluminum in storm water samples collected from August 1999 to August 2000 (USGS 2003). The same study found low levels of chlordane and various PAHs and volatile organic compounds collected using semipermeable membrane devices (SPMDs) in Pearson Creek. The SPMDs from Pearson Creek also showed genotoxicity, which indicated possible bioaccumulation of contaminants in aquatic organisms. In 2009 the environmental contractor URS Corporation conducted a study for U.S. EPA Region 7 in which they deployed SPMDs at Pearson Creek #1 during four separate time periods between April and August. The study found five pesticides (heptachlor, gamma-chlordane, alpha-chlordane, dieldrin, and 4,4'-DDD), seven polychlorinated biphenyls, and two PAHs (phenanthrene and fluoranthene) that were above laboratory reporting limits (U.S. EPA 2009). The results of the sediment samples, the USGS study, and the URS study indicate that numerous contaminants in the Pearson Creek watershed could be affecting the macroinvertebrate community, especially below Jones Branch.

6.0 Conclusions

Pearson Creek MSCI scores indicate that the protection of aquatic life designated use as listed in the Missouri WQS were not being met. Low MSCI scores are likely due to multiple contaminants in the watershed since all of the samples scored in partially supporting range. Although none of the metals or PAHs tested was above their respective PECs, zinc, cadmium, and naphthalene were present in concentrations slightly below PECs in Jones Branch. MSCI scores and macroinvertebrate community composition indicated that the Pearson Creek community was in slightly better condition at the stations upstream of Jones Branch. Several intolerant EPT taxa found previously in Pearson Creek below Jones Branch or in the Ozark/White EDU biological criteria reference streams were not found in the Pearson Creek samples.

Tests of the null hypotheses resulted in the following conclusions.

- 1) The macroinvertebrate community will not differ among longitudinally separate reaches of Pearson Creek. This hypothesis was accepted since the Pearson Creek test stations all had MSCI scores in the partially supporting range using Ozark/White EDU biological criteria.
- 2) The macroinvertebrate assemblages in the Pearson Creek samples will be similar to the Ozark/White EDU wadeable/perennial stream biological criteria. This hypothesis was rejected since the Pearson Creek test stations had MSCI scores that were in the partially supporting range. In addition, the Pearson Creek macroinvertebrate community exhibited several differences compared to reference streams such as lower taxonomic diversity, lower numbers of sensitive EPTT taxa, and lower sensitivity to water quality.
- 3) Physicochemical water quality from Pearson Creek will meet the Water Quality Standards (WQS) of Missouri (MoDNR 2014a). This hypothesis was accepted since no water quality standards were violated.
- 4) Physicochemical water quality will not differ among longitudinally separate reaches of Pearson Creek. This hypothesis was accepted since no water quality standards were violated and water constituent results were similar among the Pearson Creek test stations
- 5) Sediment constituent values will be below Probable Effect Concentrations (PEC) as described in MacDonald et al. (2000) and MacDonald et al. (2009). This hypothesis was accepted since none of the sediment constituents were above PEC values.

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Submitted by:

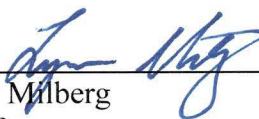


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Appendix A

Pearson Creek Bioassessment Study Macroinvertebrate Bench Sheets

Aquid Invertebrate Database Bench Sheet Report

Pearson Cr [14942], Station #1, Sample Date: 9/23/2014 3:20:00 PM

CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
"HYDRACARINA"			
Acarina	2	26	4
AMPHIPODA			
Crangonyx	48	31	27
Hyalella azteca		20	23
ARHYNCHOBDELLIDA			
Erpobdellidae	-99	1	
BASOMMATOPHORA			
Ancylidae		3	
Planorbella		1	
BRANCHIOBDELLIDA			
Branchiobdellida	1		1
COLEOPTERA			
Dubiraphia		4	9
Ectopria nervosa		1	0
Optioservus sandersoni	257	5	12
Psephenus herricki	3	2	
Scirtidae			2
Stenelmis	13	18	19
DECAPODA			
Orconectes neglectus	-99	1	-99
Orconectes virilis	-99		-99
DIPTERA			
Ablabesmyia		2	1
Antocha	1		
Brillia		1	
Corynoneura	1	1	1
Cricotopus bicinctus			1
Cricotopus/Orthocladius	2	1	1
Cryptochironomus		4	
Cryptotendipes		1	
Larsia		1	2
Micropsectra	12		11
Nanocladius			2
Neozavrelia	1		

Aquid Invertebrate Database Bench Sheet Report

Pearson Cr [14942], Station #1, Sample Date: 9/23/2014 3:20:00 PM

CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Nilotanypus			1
Parametriocnemus	2	1	
Paratendipes	2	21	
Phaenopsectra		2	
Polypedilum aviceps	1		
Polypedilum flavum	12	1	4
Polypedilum scalaenum grp	1	1	
Polypedilum trigonum		1	
Procladius		2	
Rheotanytarsus	5	3	23
Simulium	14		9
Stempellinella	6	16	15
Tanytarsus		12	21
Thienemanniella	6	1	
Thienemannimyia grp.		1	4
Tvetenia bavarica grp		1	
EPHEMEROPTERA			
Baetis	48		2
Caenis latipennis		3	
Callibaetis		1	
Dipheter	46	3	8
Leptophlebiidae		4	
Maccaffertium pulchellum	3		
Maccaffertium terminatum	2		
Stenacron	38	62	1
HEMIPTERA			
Microvelia			1
ISOPODA			
Caecidotea (Blind & Unpigmented)		8	
Lirceus	33	19	15
LUMBRICINA			
Lumbricina	-99	1	-99
NEOTAENIOGLOSSA			
Elimia	4	3	3

Aquid Invertebrate Database Bench Sheet Report

Pearson Cr [14942], Station #1, Sample Date: 9/23/2014 3:20:00 PM

CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Hydrobiidae	3		
ODONATA			
Argia	-99	2	3
Calopteryx		2	20
Gomphidae		1	
Libellulidae		1	
TRICHOPTERA			
Cheumatopsyche	58		5
Chimarra	57		2
Polycentropus		2	
Psychomyia	4		
Triaenodes			3
TRICLADIDA			
Planariidae	76	11	19
TUBIFICIDA			
Enchytraeidae		1	
Limnodrilus hoffmeisteri		1	
Potamothenix bavaricus			1
Tubificidae	7	30	1
VENEROIDA			
Corbicula	2	2	
Pisidiidae		1	

Aquid Invertebrate Database Bench Sheet Report

Pearson Cr [14941], Station #3, Sample Date: 9/23/2014 11:10:00 AM

CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
"HYDRACARINA"			
Acarina	30	1	7
AMPHIPODA			
Crangonyx	3		3
Hyalella azteca			68
ARHYNCHOBDELLIDA			
Erpobdellidae		-99	-99
BRANCHIOBDELLIDA			
Branchiobdellida			1
COLEOPTERA			
Dubiraphia		1	31
Ectopria nervosa	1		
Optioservus sandersoni	66		2
Psephenus herricki	138	32	
Stenelmis	4		4
DECAPODA			
Orconectes neglectus	2	1	-99
Orconectes ozarkae	-99		-99
Orconectes virilis			-99
DIPTERA			
Ablabesmyia		8	5
Brillia		1	
Ceratopogoninae		1	
Chelifera	1		
Chrysops	1	1	1
Corynoneura	1	4	2
Cricotopus/Orthocladius			1
Cryptochironomus		2	1
Micropsectra	5		22
Microtendipes	2	12	14
Nilotanypus	1		
Parametriocnemus	3		
Paratanytarsus			2
Paratendipes	1	58	11
Polypedilum aviceps	3		

Aquid Invertebrate Database Bench Sheet Report

Pearson Cr [14941], Station #3, Sample Date: 9/23/2014 11:10:00 AM

CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Polypedilum flavum	12		
Polypedilum illinoense grp	2	2	1
Polypedilum scalaenum grp			1
Procladius		4	
Rheocricotopus	3		
Rheotanytarsus	10		2
Simulium	20		1
Stempellinella	27	16	13
Stenochironomus		9	1
Stictochironomus		1	
Tanytarsus	7	4	15
Thienemanniella	2		1
Thienemannimyia grp.	7	3	2
Tipula	1		
Xylotopus		1	
EPHEMEROPTERA			
Baetis	23		1
Caenis latipennis	12	86	27
Choroterpes		1	
Dipheter	8		
Fallceon	1		
Leptophlebiidae	2	10	9
Maccaffertium pulchellum	53		1
Stenacron	26	30	3
LUMBRICINA			
Lumbricina	1		
LUMBRICULIDA			
Lumbriculidae		2	
MEGALOPTERA			
Sialis		1	
NEOTAENIOGLOSSA			
Elimia	-99	1	
Hydrobiidae		1	5
ODONATA			
Argia	1		1

Aquid Invertebrate Database Bench Sheet Report

Pearson Cr [14941], Station #3, Sample Date: 9/23/2014 11:10:00 AM

CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Calopteryx		2	5
Hetaerina		2	5
Stylogomphus albistylus	1	-99	-99
PLECOPTERA			
Acroneuria	1		
Perlesta	1		
Zealeuctra	5		2
TRICHOPTERA			
Cheumatopsyche	87		3
Chimarra	100		1
Oecetis			6
Polycentropus	8	1	7
Psychomyia	1		
Triaenodes			2
TRICLADIDA			
Planariidae	37		4
TUBIFICIDA			
Limnodrilus hoffmeisteri	1	7	
Tubificidae		96	12
VENEROIDA			
Corbicula	1	1	3
Pisidiidae		4	2

Aquid Invertebrate Database Bench Sheet Report

Pearson Cr [14940], Station #4, Sample Date: 9/23/2014 1:10:00 PM

CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
"HYDRACARINA"			
Acarina	10	17	8
AMPHIPODA			
Crangonyx	22	4	53
Hyaella azteca			13
ARHYNCHOBDELLIDA			
Erpobdellidae		-99	-99
BASOMMATOPHORA			
Ancylidae		5	2
Helisoma	-99		1
Menetus			1
Physella			-99
COLEOPTERA			
Dubiraphia		12	41
Ectopria nervosa	1	3	1
Optioservus sandersoni	173	10	6
Psephenus herricki	2	1	
Stenelmis		1	3
DECAPODA			
Orconectes neglectus	-99	2	1
Orconectes virilis	-99		
DIPTERA			
Ablabesmyia		1	2
Ceratopogoninae		3	1
Cryptochironomus		1	1
Labrundinia		1	
Micropsectra	18	1	8
Microtendipes		3	
Nilotanypus			1
Parametriocnemus	2		
Paratanytarsus			2
Paratendipes		18	6
Polypedilum aviceps	5		
Polypedilum scalaenum grp	2	14	1

Aquid Invertebrate Database Bench Sheet Report

Pearson Cr [14940], Station #4, Sample Date: 9/23/2014 1:10:00 PM

CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Procladius		3	
Rheotanytarsus	10	1	1
Simulium	7		
Stempellina		1	
Stempellinella	21	17	4
Stictochironomus		2	
Tanytarsus	31	1	16
Thienemannimyia grp.	18	5	15
Tipula		1	
Zavrelimyia			2
EPHEMEROPTERA			
Baetis	6		
Caenis latipennis	6	41	10
Diphetor	22		2
Leptophlebiidae	11	75	55
Maccaffertium pulchellum	4		
Stenacron	12	67	1
Stenonema femoratum		3	
ISOPODA			
Lirceus	2		4
LEPIDOPTERA			
Petrophila	1		
LUMBRICINA			
Lumbricina	3	2	1
MEGALOPTERA			
Sialis		2	1
NEOTAENIOGLOSSA			
Elimia	35	-99	6
ODONATA			
Argia	1	1	2
Calopteryx		3	
Gomphidae	2		
Hetaerina			20
Stylogomphus albistylus	2	-99	1
PLECOPTERA			

Aquid Invertebrate Database Bench Sheet Report

Pearson Cr [14940], Station #4, Sample Date: 9/23/2014 1:10:00 PM

CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Acroneuria	-99	-99	
Zealeuctra	7		
TRICHOPTERA			
Cheumatopsyche	103		1
Chimarra	23		1
Helicopsyche	6	1	1
Hydropsyche	1		
Polycentropus	1	2	4
Triaenodes			27
TRICLADIDA			
Planariidae	46	2	1
TUBIFICIDA			
Limnodrilus hoffmeisteri		2	
Potamothrix bavaricus		2	1
Tubificidae	1	67	11
VENEROIDA			
Pisidiidae	2	3	5

Aquid Invertebrate Database Bench Sheet Report

Pearson Cr [15105], Station #1, Sample Date: 3/25/2015 10:05:00 AM

CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
"HYDRACARINA"			
Acarina	3	23	2
AMPHIPODA			
Crangonyx	19	45	32
Hyalella azteca			5
Stygobromus		2	
ARHYNCHOBDELLIDA			
Erpobdellidae	-99	1	1
BASOMMATOPHORA			
Ancylidae		1	1
Helisoma			-99
Planorbella		1	
BRANCHIOBDELLIDA			
Branchiobdellida			6
COLEOPTERA			
Dubiraphia			3
Optioservus sandersoni	157	2	4
Psephenus herricki	1		
Scirtidae			2
Stenelmis	14	14	4
DECAPODA			
Orconectes neglectus	-99	-99	1
Orconectes virilis	-99		-99
DIPTERA			
Ablabesmyia		2	
Brillia		2	1
Ceratopogoninae		5	1
Chaetocladius		1	
Corynoneura		7	3
Cricotopus bicinctus			1
Cricotopus/Orthocladius	48	8	24
Cryptochironomus	2	3	
Dicrotendipes		5	3
Eukiefferiella	79	4	40
Micropsectra	37	7	38

Aquid Invertebrate Database Bench Sheet Report

Pearson Cr [15105], Station #1, Sample Date: 3/25/2015 10:05:00 AM

CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Microtendipes		2	
Nanocladius			1
Nilotanytus		1	
Parakiefferiella		2	1
Parametriocnemus	2		1
Paratendipes		105	7
Polypedilum aviceps	18		3
Polypedilum flavum	9		
Polypedilum illinoense grp			4
Polypedilum scalaenum grp	1	6	
Rheotanytarsus	10	1	17
Simulium	2		9
Stempellinella	3	15	3
Stenochironomus		1	1
Tanytarsus	2	11	8
Thienemanniella	1	8	73
Thienemannimyia grp.	8	8	12
Tvetenia bavarica grp	11		7
EPHEMEROPTERA			
Baetis	1		1
Dipheter	64	1	19
Isonychia bicolor		1	
Leptophlebia		1	
Maccaffertium pulchellum	3		
Stenacron	16	15	
Stenonema femoratum		1	
HAPLOTAXIDA			
Haplotaxis		1	
HEMIPTERA			
Belostoma			-99
Microvelia			1
ISOPODA			
Caecidotea (Blind & Unpigmented)		2	
Lirceus	63	23	26

Aquid Invertebrate Database Bench Sheet Report

Pearson Cr [15105], Station #1, Sample Date: 3/25/2015 10:05:00 AM

CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
LUMBRICINA			
Lumbricina	2	1	-99
NEOTAENIOGLOSSA			
Elimia	6	1	-99
RHYNCHOBDELLIDA			
Glossiphoniidae	-99		
TRICHOPTERA			
Cheumatopsyche	19	1	2
Chimarra	17		
Glossosomatidae			1
Hydroptila	1		3
Psychomyia	14		
TRICLADIDA			
Planariidae	66	1	2
TUBIFICIDA			
Enchytraeidae	1	1	
Limnodrilus hoffmeisteri		15	
Potamothenix bavaricus		1	
Tubificidae	9	39	1
VENEROIDA			
Pisidiidae	4	3	1

Aquid Invertebrate Database Bench Sheet Report

Pearson Cr [15106], Station #3, Sample Date: 3/25/2015 11:40:00 AM

CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
"HYDRACARINA"			
Acarina	6	14	8
AMPHIPODA			
Crangonyx	1	1	-99
Hyalella azteca			11
ARHYNCHOBDELLIDA			
Erpobdellidae		-99	
BASOMMATOPHORA			
Ancylidae		1	
COLEOPTERA			
Dubiraphia		1	14
Optioservus sandersoni	12		1
Psephenus herricki	16	7	-99
Stenelmis	3		2
DECAPODA			
Orconectes neglectus	-99	-99	-99
DIPTERA			
Ablabesmyia		9	4
Ceratopogoninae	1	7	2
Chironomidae	1	3	4
Clinocera	2		-99
Cricotopus/Orthocladius	14	12	23
Cryptochironomus		3	1
Eukiefferiella	84	9	31
Eukiefferiella brehmi grp	24	2	1
Eukiefferiella gracei grp			4
Hemerodromia	1		
Hydrobaenus		4	4
Micropsectra	39	18	55
Microtendipes	1	2	4
Nilotanypus		1	
Orthocladius (Euorthocladius)		1	
Parakiefferiella		1	1
Parametriocnemus	2		
Paratendipes		175	13

Aquid Invertebrate Database Bench Sheet Report

Pearson Cr [15106], Station #3, Sample Date: 3/25/2015 11:40:00 AM

CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Polypedilum aviceps	27		1
Polypedilum flavum	14	1	1
Polypedilum scalaenum grp		7	1
Potthastia		1	1
Procladius			1
Rheocricotopus	66	2	21
Rheotanytarsus	18		7
Simulium	2		
Stempellina		1	
Stempellinella	17	17	18
Stictochironomus		1	
Sympotthastia	2	1	3
Tabanus		1	
Tanytarsus	4	4	16
Thienemanniella	1	1	
Thienemannimyia grp.	8	1	15
Tipula	-99		1
Tvetenia bavarica grp			1
EPHEMEROPTERA			
Caenis latipennis		23	9
Dipheter	21		3
Leptophlebia		2	3
Maccaffertium pulchellum	35		-99
Maccaffertium terminatum			-99
Stenacron	9	5	2
LUMBRICINA			
Lumbricina		-99	-99
NEOTAENIOGLOSSA			
Elimia	3	-99	10
Pleuroceridae		1	1
ODONATA			
Calopteryx			3
Stylogomphus albistylus	1		-99
PLECOPTERA			
Acroneuria	-99		

Aquid Invertebrate Database Bench Sheet Report

Pearson Cr [15106], Station #3, Sample Date: 3/25/2015 11:40:00 AM

CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Leuctridae	34		7
Perlidae	2		
TRICHOPTERA			
Cheumatopsyche	24	-99	3
Chimarra	33		
Helicopsyche	2		3
Hydroptila	11	4	27
Neophylax	1		-99
Polycentropus			-99
Psychomyia			1
Pycnopsyche			1
Rhyacophila	2		
Triaenodes			8
TRICLADIDA			
Planariidae	25		1
TUBIFICIDA			
Aulodrilus		4	
Limnodrilus hoffmeisteri		2	1
Tubificidae		25	5
VENEROIDA			
Pisidiidae		1	1

Aquid Invertebrate Database Bench Sheet Report

Pearson Cr [15107], Station #4, Sample Date: 3/25/2015 12:45:00 PM

CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
"HYDRACARINA"			
Acarina	16	11	13
AMPHIPODA			
Crangonyx	90	3	36
Hyalella azteca			8
ARHYNCHOBDELLIDA			
Erpobdellidae	-99	1	1
BASOMMATOPHORA			
Ancylidae		8	1
Helisoma			-99
Physella		2	
Planorbella		6	2
BRANCHIOBDELLIDA			
Branchiobdellida			1
COLEOPTERA			
Dubiraphia			28
Dytiscidae		1	
Ectopria nervosa	1	1	
Laccophilus			-99
Optioservus sandersoni	119		
Stenelmis	4		3
DECAPODA			
Orconectes neglectus	-99	-99	-99
DIPTERA			
Ablabesmyia		14	3
Caloparyphus	1		
Ceratopogoninae		7	7
Chelifera	3		
Chironomidae	11	1	1
Clinocera	1		
Corynoneura		1	
Cricotopus bicinctus	4		
Cricotopus sylvestris grp	1		2
Cricotopus trifascia			1
Cricotopus/Orthocladius	131	7	29

Aquid Invertebrate Database Bench Sheet Report

Pearson Cr [15107], Station #4, Sample Date: 3/25/2015 12:45:00 PM

CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Cryptochironomus		2	
Diamesa	2		
Dicrotendipes		1	
Eukiefferiella	36	3	1
Eukiefferiella brehmi grp	16		4
Hemerodromia	6		
Hydrobaenus		4	
Micropsectra	114	14	29
Microtendipes		4	1
Nilotanypus	2	1	
Parakiefferiella			1
Paramerina		1	
Parametriocnemus	3		
Paratendipes		93	11
Phaenopsectra		1	
Polypedilum aviceps	38		4
Polypedilum flavum	1		
Polypedilum scalaenum grp	5	29	3
Polypedilum tritum			1
Potthastia	1	6	6
Procladius		8	
Rheocricotopus	8		
Rheotanytarsus	25		6
Simulium	1		
Stempellina	1		
Stempellinella	5	9	3
Sympotthastia			3
Tanytarsus	39	10	29
Thienemanniella	1	3	1
Thienemannimyia grp.	98	1	15
Tvetenia bavarica grp	1		
Zavrelimyia		2	1
EPHEMEROPTERA			
Caenis latipennis	6	8	6
Dipheter	69		4

Aquid Invertebrate Database Bench Sheet Report

Pearson Cr [15107], Station #4, Sample Date: 3/25/2015 12:45:00 PM

CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Eurylophella bicolor			1
Leptophlebia	1	9	14
Leptophlebiidae	1	1	3
Paraleptophlebia			3
Stenacron	57	8	
Stenonema femoratum	-99	1	
ISOPODA			
Caecidotea			10
Lirceus	2	1	1
LUMBRICINA			
Lumbricina	1	1	
MEGALOPTERA			
Sialis		-99	-99
NEOTAENIOGLOSSA			
Elimia	3	1	5
ODONATA			
Calopteryx			1
Gomphidae	1		
Stylogomphus albistylus		-99	-99
PLECOPTERA			
Acroneuria	1		
Amphinemura	1		
Clioperla clio	-99		
Isoperla	1		
Leuctridae	57		1
Perlesta	1		
TRICHOPTERA			
Cheumatopsyche	10		
Chimarra	10		
Helicopsyche	4		
Hydroptila	2		
Pycnopsyche			-99
Rhyacophila	22		
Trienodes			8
TRICLADIDA			

Aquid Invertebrate Database Bench Sheet Report

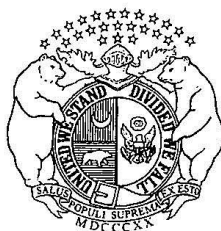
Pearson Cr [15107], Station #4, Sample Date: 3/25/2015 12:45:00 PM

CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

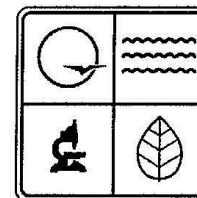
ORDER: TAXA	CS	NF	RM
Planariidae	47	2	1
TUBIFICIDA			
Enchytraeidae		1	
Tubificidae	3	30	7
VENEROIDA			
Pisidiidae	2		4

Appendix B

Laboratory Analytical Reports



Missouri Department of Natural Resources Environmental Services Program



Order ID 140926018 Program, Contact: WPC Trish Rielly
Report Date: 11/12/2014 LDPR/JobCode: FEBIO



Sample: AC36492



Customer #: 1411951

Facility ID:

County: Greene

Collector: MIKE IRWIN

Entry Point:

Sample Comment: Grab; Water, Pearson Creek #4, located downstream of Highway YY, Legal Description: NE 1/4, Sec. 13, T29N, R21W.

Site: Pearson Creek Bioassessment Study

Sample Reference ID:

Affiliation: ESP

Collect Date: 9/23/2014 1:10:00PM

UTM-Easting 484815E
Northing 4119533N

Precision
5.6 m

Test	Parameter	Result	Qualifier	Units	Method
00.7 Metals-Dissolved	Calcium	71.5		mg/L	EPA 200.7
00.7 Metals-Dissolved	Magnesium	5.89		mg/L	EPA 200.7
00.8 Metals-Dissolved	Arsenic	<0.50	ND	µg/L	EPA 200.8
00.8 Metals-Dissolved	Barium	64.5		µg/L	EPA 200.8
00.8 Metals-Dissolved	Cadmium	<0.10	ND	µg/L	EPA 200.8
00.8 Metals-Dissolved	Chromium	4.70		µg/L	EPA 200.8
00.8 Metals-Dissolved	Cobalt	<1	ND	µg/L	EPA 200.8
00.8 Metals-Dissolved	Copper	<0.50	ND	µg/L	EPA 200.8
00.8 Metals-Dissolved	Lead	<0.50	ND	µg/L	EPA 200.8
00.8 Metals-Dissolved	Manganese	8.00		µg/L	EPA 200.8
00.8 Metals-Dissolved	Mercury	<0.10	ND	µg/L	EPA 200.8
00.8 Metals-Dissolved	Nickel	0.92	05	µg/L	EPA 200.8
00.8 Metals-Dissolved	Selenium	<1	ND	µg/L	EPA 200.8
00.8 Metals-Dissolved	Thallium	<0.50	ND	µg/L	EPA 200.8
00.8 Metals-Dissolved	Zinc	1.49		µg/L	EPA 200.8
Ammonia as N	Ammonia as N	<0.03	ND	mg/L	L 10-107-06-1-J
Chloride	Chloride	16.6		mg/L	L 10-117-07-1-A
Field Dissolved Oxygen	Field Dissolved Oxygen	9.78		mg/L	SM 4500-O-G
Field pH	Field pH	8.2		pH Units	EPA 150.1
Field Specific Conductivity	Field Specific Conductivity	430 µS/cm			SM 2510
Field Temperature	Field Temperature	15.8 C			EPA 170.1
Field Turbidity	Field Turbidity	1.06		NTU	EPA 180.1
Flow	Flow	3.83 cfs			Field Dependent
Hardness as CaCO3 Dissolved-N	Hardness as CaCO3 Dissolved-N	203		mg/L	SM 2340-B
Nitrate + Nitrite as N	Nitrate + Nitrite as N	1.92		mg/L	L 10-107-04-1-C
Sulfate	Sulfate	7.04		mg/L	L 10-116-10-2-A

Sample: AC36492		Facility ID:		Site: Pearson Creek Bioassessment Study	
		County: Greene		Sample Reference ID:	
Customer #: 1411951		Collector: MIKE IRWIN		Affiliation: ESP	
		Entry Point:		Collect Date: 9/23/2014 1:10:00PM	
		Sample Comment:		Grab; Water, Pearson Creek #4, located downstream of Highway YY, Legal Description: NE 1/4, Sec. 13, T29N, R21W.	
		Precision			
		5.6 m			
UTM-Easting		Northing			
484815E		4119533N			

Test	Parameter	Result	Qualifier	Units	Method
Total Nitrogen	Total Nitrogen	1.83		mg/L	USGS I-2650-03
Total Phosphorus	Total Phosphorus	0.036	05	mg/L	USGS I-2650-03
Total Suspended Solids (TSS) / NFR	Total Suspended Solids (TSS) / NFR	<5	ND	mg/L	SM 2540-D

Sample: AC36493		Facility ID:		Site: Pearson Creek Bioassessment Study	
		County: Greene		Sample Reference ID:	
Customer #: 1411952		Collector: MIKE IRWIN		Affiliation: ESP	
		Entry Point:		Collect Date: 9/23/2014 11:00:00AM	
		Sample Comment:		Grab; Water, Pearson Creek #3, located upstream of Farm Road 136 (Cherry Street). Legal Description: NW 1/4, Sec. 23, T29N, R21W.	
		Precision			
		3.2 m			
UTM-Easting		Northing			
481938E		4117438N			

Test	Parameter	Result	Qualifier	Units	Method
200.7 Metals-Dissolved	Calcium	73.2		mg/L	EPA 200.7
200.7 Metals-Dissolved	Magnesium	6.14		mg/L	EPA 200.7
200.8 Metals-Dissolved	Arsenic	<0.50	ND	µg/L	EPA 200.8
200.8 Metals-Dissolved	Barium	65.0		µg/L	EPA 200.8
200.8 Metals-Dissolved	Cadmium	<0.10	ND	µg/L	EPA 200.8
200.8 Metals-Dissolved	Chromium	3.36		µg/L	EPA 200.8
200.8 Metals-Dissolved	Cobalt	<1	ND	µg/L	EPA 200.8
200.8 Metals-Dissolved	Copper	<0.50	ND	µg/L	EPA 200.8
200.8 Metals-Dissolved	Lead	<0.50	ND	µg/L	EPA 200.8
200.8 Metals-Dissolved	Manganese	5.76		µg/L	EPA 200.8
200.8 Metals-Dissolved	Mercury	<0.10	ND	µg/L	EPA 200.8
200.8 Metals-Dissolved	Nickel	0.90	05	µg/L	EPA 200.8
200.8 Metals-Dissolved	Selenium	<1	ND	µg/L	EPA 200.8
200.8 Metals-Dissolved	Thallium	<0.50	ND	µg/L	EPA 200.8
200.8 Metals-Dissolved	Zinc	2.47		µg/L	EPA 200.8
Ammonia as N	Ammonia as N	<0.03	ND	mg/L	L 10-107-06-1-J
Chloride	Chloride	15.1		mg/L	L 10-117-07-1-A
Field Dissolved Oxygen	Field Dissolved Oxygen	9.50		mg/L	SM 4500-O-G
Field pH	Field pH	8.3		pH Units	EPA 150.1
Field Specific Conductivity	Field Specific Conductivity	434 uS/cm			SM 2510
Field Temperature	Field Temperature	15.3 C			EPA 170.1
Field Turbidity	Field Turbidity	1.56		NTU	EPA 180.1
Flow	Flow	4.36 cfs			Field Dependent

Sample: AC36493**Customer #:** 1411952**UTM-Easting**
481938E**Northing**
4117438N**Facility ID:****County:** Greene**Collector:** MIKE IRWIN**Entry Point:****Sample Comment:****Precision**
3.2 m

Grab; Water, Pearson Creek #3, located upstream of Farm Road 136 (Cherry Street). Legal Description: NW 1/4, Sec. 23, T29N, R21W.

Site: Pearson Creek Bioassessment Study**Sample Reference ID:****Affiliation:** ESP**Collect Date:** 9/23/2014 11:00:00AM

Test	Parameter	Result	Qualifier	Units	Method
Hardness as CaCO3 Dissolved-N	Hardness as CaCO3 Dissolved-N	208		mg/L	SM 2340-B
Nitrate + Nitrite as N	Nitrate + Nitrite as N	1.79		mg/L	L 10-107-04-1-C
Sulfate	Sulfate	6.93		mg/L	L 10-116-10-2-A
Total Nitrogen	Total Nitrogen	1.67		mg/L	USGS I-2650-03
Total Phosphorus	Total Phosphorus	0.042	05	mg/L	USGS I-2650-03
Total Suspended Solids (TSS) / NFR	Total Suspended Solids (TSS) / NFR	<5	ND	mg/L	SM 2540-D

Sample: AC36494**Customer #:** 1411953**UTM-Easting**
182412E**Northing**
4114585N**Facility ID:****County:** Greene**Collector:** MIKE IRWIN**Entry Point:****Sample Comment:****Precision**
2.5 m

Grab; Water, Pearson Creek #1, located downstream of Farm Road 148 (Old Sunshine Street). Legal Description: N 1/2, Sec. 35, T29N, R21W.

Site: Pearson Creek Bioassessment Study**Sample Reference ID:****Affiliation:** ESP**Collect Date:** 9/23/2014 3:15:00PM

Test	Parameter	Result	Qualifier	Units	Method
00.7 Metals-Dissolved	Calcium	85.9		mg/L	EPA 200.7
00.7 Metals-Dissolved	Magnesium	4.80		mg/L	EPA 200.7
00.8 Metals-Dissolved	Arsenic	<0.50	ND	µg/L	EPA 200.8
00.8 Metals-Dissolved	Barium	80.7		µg/L	EPA 200.8
00.8 Metals-Dissolved	Cadmium	<0.10	ND	µg/L	EPA 200.8
00.8 Metals-Dissolved	Chromium	4.62		µg/L	EPA 200.8
00.8 Metals-Dissolved	Cobalt	<1	ND	µg/L	EPA 200.8
00.8 Metals-Dissolved	Copper	0.60	05	µg/L	EPA 200.8
00.8 Metals-Dissolved	Lead	<0.50	ND	µg/L	EPA 200.8
00.8 Metals-Dissolved	Manganese	7.99		µg/L	EPA 200.8
00.8 Metals-Dissolved	Mercury	<0.10	ND	µg/L	EPA 200.8
00.8 Metals-Dissolved	Nickel	1.11		µg/L	EPA 200.8
00.8 Metals-Dissolved	Selenium	<1	ND	µg/L	EPA 200.8
00.8 Metals-Dissolved	Thallium	<0.50	ND	µg/L	EPA 200.8
00.8 Metals-Dissolved	Zinc	5.98		µg/L	EPA 200.8
Ammonia as N	Ammonia as N	<0.03	ND	mg/L	L 10-107-06-1-J
Chloride	Chloride	20.8		mg/L	L 10-117-07-1-A
Field Dissolved Oxygen	Field Dissolved Oxygen	9.80		mg/L	SM 4500-O-G
Field pH	Field pH	7.9		pH Units	EPA 150.1
Field Specific Conductivity	Field Specific Conductivity	495 uS/cm			SM 2510

Sample: AC36494



Customer #: 1411953

UTM-Easting
482412ENorthing
4114585N

Facility ID:

County: Greene

Collector: MIKE IRWIN

Entry Point:

Sample Comment:

Precision

2.5 m

Site: Pearson Creek Bioassessment Study

Sample Reference ID:

Affiliation: ESP

Collect Date: 9/23/2014 3:15:00PM

Grab; Water, Pearson Creek #1, located downstream of Farm Road 148 (Old Sunshine Street). Legal Description: N 1/2, Sec. 35, T29N, R21W.

Test	Parameter	Result	Qualifier	Units	Method
Field Temperature	Field Temperature	18.4 C			EPA 170.1
Field Turbidity	Field Turbidity	2.10		NTU	EPA 180.1
Flow	Flow	9.62 cfs			Field Dependent
Hardness as CaCO3 Dissolved-N	Hardness as CaCO3 Dissolved-N	234		mg/L	SM 2340-B
Nitrate + Nitrite as N	Nitrate + Nitrite as N	2.49	09	mg/L	L 10-107-04-1-C
Sulfate	Sulfate	8.62		mg/L	L 10-116-10-2-A
Total Nitrogen	Total Nitrogen	2.29		mg/L	USGS I-2650-03
Total Phosphorus	Total Phosphorus	0.036	05	mg/L	USGS I-2650-03
Total Suspended Solids (TSS) / NFR	Total Suspended Solids (TSS) / NFR	<5	ND	mg/L	SM 2540-D

Sample: AC36495



Customer #: 1411954

UTM-Easting
482124ENorthing
4115610N

Facility ID:

County: Greene

Collector: MIKE IRWIN

Entry Point:

Sample Comment:

Precision

5.4 m

Site: Pearson Creek Bioassessment Study

Sample Reference ID:

Affiliation: ESP

Collect Date: 9/23/2014 5:05:00PM

Grab; Water, Jones Spring Branch, located downstream of South Leaning Tree Lane. Legal Description: NW 1/4, Sec. 26, T29N, R21W.

Test	Parameter	Result	Qualifier	Units	Method
200.7 Metals-Dissolved	Calcium	97.6		mg/L	EPA 200.7
200.7 Metals-Dissolved	Magnesium	2.84		mg/L	EPA 200.7
200.8 Metals-Dissolved	Arsenic	<0.50	ND	µg/L	EPA 200.8
200.8 Metals-Dissolved	Barium	82.7		µg/L	EPA 200.8
200.8 Metals-Dissolved	Cadmium	<0.10	ND	µg/L	EPA 200.8
200.8 Metals-Dissolved	Chromium	4.80		µg/L	EPA 200.8
200.8 Metals-Dissolved	Cobalt	<1	ND	µg/L	EPA 200.8
200.8 Metals-Dissolved	Copper	<0.50	ND	µg/L	EPA 200.8
200.8 Metals-Dissolved	Lead	<0.50	ND	µg/L	EPA 200.8
200.8 Metals-Dissolved	Manganese	15.7		µg/L	EPA 200.8
200.8 Metals-Dissolved	Mercury	<0.10	ND	µg/L	EPA 200.8
200.8 Metals-Dissolved	Nickel	1.44		µg/L	EPA 200.8
200.8 Metals-Dissolved	Selenium	1.10	05	µg/L	EPA 200.8
200.8 Metals-Dissolved	Thallium	<0.50	ND	µg/L	EPA 200.8
200.8 Metals-Dissolved	Zinc	1.84		µg/L	EPA 200.8
Ammonia as N	Ammonia as N	<0.03	ND	mg/L	L 10-107-06-1-J
Chloride	Chloride	34.7		mg/L	L 10-117-07-1-A

Sample: AC36495**Customer #:** 1411954**UTM-Easting**
482124E**Northing**
4115610N**Facility ID:****County:** Greene**Collector:** MIKE IRWIN**Entry Point:****Sample Comment:****Precision**
5.4 m

Grab; Water, Jones Spring Branch, located downstream of South Leaning Tree Lane. Legal Description: NW 1/4, Sec. 26, T29N, R21W.

Site: Pearson Creek Bioassessment Study**Sample Reference ID:****Affiliation:** ESP**Collect Date:** 9/23/2014 5:05:00PM

Test	Parameter	Result	Qualifier	Units	Method
Field Dissolved Oxygen	Field Dissolved Oxygen	9.67		mg/L	SM 4500-O-G
Field pH	Field pH	8.3		pH Units	EPA 150.1
Field Specific Conductivity	Field Specific Conductivity	562 uS/cm			SM 2510
Field Temperature	Field Temperature	18.4 C			EPA 170.1
Field Turbidity	Field Turbidity	2.31		NTU	EPA 180.1
Hardness as CaCO3 Dissolved-N	Hardness as CaCO3 Dissolved-N	255		mg/L	SM 2340-B
Nitrate + Nitrite as N	Nitrate + Nitrite as N	2.68	09	mg/L	L 10-107-04-1-C
Sulfate	Sulfate	10.0		mg/L	L 10-116-10-2-A
Total Nitrogen	Total Nitrogen	2.40		mg/L	USGS I-2650-03
Total Phosphorus	Total Phosphorus	0.024	05	mg/L	USGS I-2650-03
Total Suspended Solids (TSS) / NFR	Total Suspended Solids (TSS) / NFR	<5	ND	mg/L	SM 2540-D

Sample: AC36496**Customer #:** 1411955**UTM-Easting**
480803E**Northing**
4087061N**Facility ID:****County:** Douglas**Collector:** MIKE IRWIN**Entry Point:****Sample Comment:****Precision**
5.5 m

Grab; Water, Rockhouse Hollow #1, located near Highway AP. Legal Description: SE 1/4, Sec. 13, T26N, R11W.

Site: Headwater Candidate Reference Study**Sample Reference ID:****Affiliation:** ESP**Collect Date:** 9/24/2014 11:30:00AM

Test	Parameter	Result	Qualifier	Units	Method
00.7 Metals-Total Recoverable	Calcium	54.6		mg/L	EPA 200.7
00.7 Metals-Total Recoverable	Magnesium	32.6		mg/L	EPA 200.7
Ammonia as N	Ammonia as N	<0.03	ND	mg/L	L 10-107-06-1-J
Chloride	Chloride	1.95	05	mg/L	L 10-117-07-1-A
Field Dissolved Oxygen	Field Dissolved Oxygen	9.12		mg/L	SM 4500-O-G
Field pH	Field pH	8.2		pH Units	EPA 150.1
Field Specific Conductivity	Field Specific Conductivity	425 uS/cm			SM 2510
Field Temperature	Field Temperature	14.5 C			EPA 170.1
Field Turbidity	Field Turbidity	< 1		NTU	EPA 180.1
Flow	Flow	0.26 cfs			Field Dependent
Hardness as CaCO3-TR-N	Hardness as CaCO3-TR-N	271		mg/L	SM 2340-B
Nitrate + Nitrite as N	Nitrate + Nitrite as N	0.064		mg/L	L 10-107-04-1-C
Sulfate	Sulfate	6.24		mg/L	L 10-116-10-2-A
Total Nitrogen	Total Nitrogen	0.088	05	mg/L	USGS I-2650-03
Total Phosphorus	Total Phosphorus	<0.01	ND	mg/L	USGS I-2650-03

Sample: AC36496



Customer #: 1411955

UTM-Easting Northing
580803E 4087061N

Facility ID:

County: Douglas

Collector: MIKE IRWIN

Entry Point:

Sample Comment:

Precision

5.5 m

Site: Headwater Candidate Reference Study

Sample Reference ID:

Affiliation: ESP

Collect Date: 9/24/2014 11:30:00AM

Grab; Water, Rockhouse Hollow #1, located near Highway AP. Legal Description: SE 1/4, Sec. 13, T26N, R11W.

Test	Parameter	Result	Qualifier	Units	Method
Total Suspended Solids (TSS) / NFR	Total Suspended Solids (TSS) / NFR	<5	ND	mg/L	SM 2540-D

Sample: AC36497



Customer #: 1411937

UTM-Easting Northing
481938E 4117438N

Facility ID:

County: Greene

Collector: MIKE IRWIN

Entry Point:

Sample Comment:

Precision

3.2 m

Site: Pearson Creek Bioassessment Study

Sample Reference ID:

Affiliation: ESP

Collect Date: 9/23/2014 12:10:00PM

Composite; Sediment, Pearson Creek #3, located upstream of Farm Road 136 (Cherry Street). Legal Description: NW 1/4, Sec. 23, T29N, R21W

Test	Parameter	Result	Qualifier	Units	Method
6010B Metals-Total Recoverable	Arsenic	4810		µg/kg	SW 846 6010B
6010B Metals-Total Recoverable	Barium	172000		µg/kg	SW 846 6010B
6010B Metals-Total Recoverable	Cadmium	459	05	µg/kg	SW 846 6010B
6010B Metals-Total Recoverable	Chromium	31000		µg/kg	SW 846 6010B
6010B Metals-Total Recoverable	Cobalt	15000		µg/kg	SW 846 6010B
6010B Metals-Total Recoverable	Copper	13300		µg/kg	SW 846 6010B
6010B Metals-Total Recoverable	Lead	22100		µg/kg	SW 846 6010B
6010B Metals-Total Recoverable	Manganese	1050000		µg/kg	SW 846 6010B
6010B Metals-Total Recoverable	Nickel	20200		µg/kg	SW 846 6010B
6010B Metals-Total Recoverable	Selenium	<1000	ND	µg/kg	SW 846 6010B
6010B Metals-Total Recoverable	Thallium	1850	05	µg/kg	SW 846 6010B
6010B Metals-Total Recoverable	Zinc	76700		µg/kg	SW 846 6010B
BNAs	1,2,4-Trichlorobenzene	<130	09, ND	µg/kg	8270C
BNAs	1,2-Dichlorobenzene	<130	09, ND	µg/kg	8270C
BNAs	1,3-Dichlorobenzene	<130	09, ND	µg/kg	8270C
BNAs	1,4-Dichlorobenzene	<130	09, ND	µg/kg	8270C
BNAs	2,4,6-Trichlorophenol	<130	09, ND	µg/kg	8270C
BNAs	2,4,6-Trichlorophenol	<260	09, ND	µg/kg	8270C
BNAs	2,4-Dichlorophenol	<130	09, ND	µg/kg	8270C
BNAs	2,4-Dimethylphenol	<130	09, ND	µg/kg	8270C
BNAs	2,4-Dinitrophenol	<1300	09, ND	µg/kg	8270C
BNAs	2,4-Dinitrotoluene	<520	09, ND	µg/kg	8270C
BNAs	2,6-Dinitrotoluene	<130	09, ND	µg/kg	8270C
BNAs	2-Chloronaphthalene	<260	09, ND	µg/kg	8270C
BNAs	2-Chlorophenol	<130	09, ND	µg/kg	8270C

Sample: AC36497



Customer #: 1411937

Facility ID:

County: Greene

Collector: MIKE IRWIN

Entry Point:

Sample Comment:

Precision

3.2 m

Site: Pearson Creek Bioassessment Study

Sample Reference ID:

Affiliation: ESP

Collect Date: 9/23/2014 12:10:00PM

UTM-Easting
481938ENorthing
4117438N

Composite; Sediment, Pearson Creek #3, located upstream of Farm Road 136 (Cherry Street). Legal Description. NW 1/4, Sec. 23, T29N, R21W

Test	Parameter	Result	Qualifier	Units	Method
BNAs	2-Methyl-4,6-dinitrophenol	<520	09, ND	µg/kg	8270C
BNAs	2-Methylnaphthalene	<130	09, ND	µg/kg	8270C
BNAs	2-Methylphenol	<130	09, ND	µg/kg	8270C
BNAs	2-Nitroaniline	<130	09, ND	µg/kg	8270C
3NAs	2-Nitrophenol	<130	09, ND	µg/kg	8270C
3NAs	3,3-Dichlorobenzidine	<130	09, ND	µg/kg	8270C
3NAs	3-Nitroaniline	<130	09, ND	µg/kg	8270C
3NAs	4-Bromophenyl phenyl ether	<130	09, ND	µg/kg	8270C
3NAs	4-Chloro-3-methylphenol	<130	09, ND	µg/kg	8270C
3NAs	4-Chloroaniline	<130	09, ND	µg/kg	8270C
3NAs	4-Chlorophenyl phenyl ether	<260	09, ND	µg/kg	8270C
3NAs	4-Methylphenol	<260	09, ND	µg/kg	8270C
3NAs	4-Nitroaniline	<130	09, ND	µg/kg	8270C
3NAs	4-Nitrophenol	<260	09, ND	µg/kg	8270C
iNAs	Acenaphthene	<130	09, ND	µg/kg	8270C
iNAs	Acenaphthylene	<130	09, ND	µg/kg	8270C
iNAs	Anthracene	<130	09, ND	µg/kg	8270C
iNAs	azobenzene	<130	09, ND	µg/kg	8270C
iNAs	Benzo(a)anthracene	<130	09, ND	µg/kg	8270C
NAs	Benzo(a)pyrene	<130	09, ND	µg/kg	8270C
NAs	Benzo(b)fluoranthene	<130	09, ND	µg/kg	8270C
NAs	Benzo(ghi)perylene	<130	09, ND	µg/kg	8270C
NAs	Benzo(k)fluoranthene	<130	09, ND	µg/kg	8270C
NAs	Benzoic Acid	<260	09, ND	µg/kg	8270C
NAs	bis(2-Chloroethoxy)methane	<520	09, ND	µg/kg	8270C
NAs	bis(2-Chloroethyl)ether	<130	09, ND	µg/kg	8270C
NAs	bis(2-chloroisopropyl)ether	<130	09, ND	µg/kg	8270C
VAs	bis(2-Ethylhexyl) phthalate	<260	09, ND	µg/kg	8270C
VAs	Butyl benzyl phthalate	<260	09, ND	µg/kg	8270C
VAs	Chrysene	<130	09, ND	µg/kg	8270C
VAs	Dibenzo(a,h)anthracene	<130	09, ND	µg/kg	8270C
VAs	Dibenzofuran	<130	09, ND	µg/kg	8270C
VAs	Diethyl phthalate	<520	09, ND	µg/kg	8270C
VAs	Dimethyl phthalate	<130	09, ND	µg/kg	8270C
VAs	Di-n-butyl phthalate	<130	09, ND	µg/kg	8270C

Sample: AC36497



Customer #: 1411937

UTM-Easting
481938ENorthing
4117438N

Facility ID:

County: Greene

Collector: MIKE IRWIN

Entry Point:

Sample Comment:

Precision

3.2 m

Composite; Sediment, Pearson Creek #3, located upstream of Farm Road 136 (Cherry Street). Legal Description. NW 1/4, Sec. 23, T29N, R21W

Site: Pearson Creek Bioassessment Study

Sample Reference ID:

Affiliation: ESP

Collect Date: 9/23/2014 12:10:00PM

Test	Parameter	Result	Qualifier	Units	Method
BNAs	Di-n-octyl phthalate	<130	09, ND	µg/kg	8270C
BNAs	Fluoranthene	<130	09, ND	µg/kg	8270C
BNAs	Fluorene	<130	09, ND	µg/kg	8270C
BNAs	Hexachlorobenzene	<130	09, ND	µg/kg	8270C
BNAs	Hexachlorobutadiene	<130	09, ND	µg/kg	8270C
BNAs	Hexachlorocyclopentadiene	<260	09, ND	µg/kg	8270C
BNAs	Hexachloroethane	<130	09, ND	µg/kg	8270C
BNAs	Indeno(1,2,3-cd)pyrene	<130	09, ND	µg/kg	8270C
BNAs	Isophorone	<130	09, ND	µg/kg	8270C
BNAs	Naphthalene	<130	09, ND	µg/kg	8270C
BNAs	Nitrobenzene	<130	09, ND	µg/kg	8270C
BNAs	n-Nitroso-di-n-propylamine	<130	09, ND	µg/kg	8270C
BNAs	n-Nitrosodiphenylamine	<1300	09, ND	µg/kg	8270C
BNAs	Pentachlorophenol	<130	09, ND	µg/kg	8270C
BNAs	Phenanthrene	<130	09, ND	µg/kg	8270C
BNAs	Phenol	<130	09, ND	µg/kg	8270C
BNAs	Pyrene	<130	09, ND	µg/kg	8270C
Mercury-Total Recoverable	Mercury-Total Recoverable	41.3		µg/kg	SW 846 - 7471A
Percent Moisture	Percent Moisture	61.6		%	Infrared Drying

Sample: AC36498



Customer #: 1411938

UTM-Easting
482412ENorthing
4114585N

Facility ID:

County: Greene

Collector: MIKE IRWIN

Entry Point:

Sample Comment:

Precision

2.5 m

Composite; Sediment, Pearson Creek #1, located upstream of Farm Road 148 (Old Sunshine Street). Legal Description. N 1/2, Sec. 35, T29N, R21W

Site: Pearson Creek Bioassessment Study

Sample Reference ID:

Affiliation: ESP

Collect Date: 9/23/2014 4:30:00PM

Test	Parameter	Result	Qualifier	Units	Method
6010B Metals-Total Recoverable	Arsenic	3500		µg/kg	SW 846 6010B
6010B Metals-Total Recoverable	Barium	127000		µg/kg	SW 846 6010B
6010B Metals-Total Recoverable	Cadmium	2280		µg/kg	SW 846 6010B
6010B Metals-Total Recoverable	Chromium	23900		µg/kg	SW 846 6010B
6010B Metals-Total Recoverable	Cobalt	11600		µg/kg	SW 846 6010B
6010B Metals-Total Recoverable	Copper	13900		µg/kg	SW 846 6010B
6010B Metals-Total Recoverable	Lead	46800		µg/kg	SW 846 6010B

Sample: AC36498



Customer #: 1411938

Facility ID:

County: Greene

Collector: MIKE IRWIN

Entry Point:

Sample Comment:

Precision

2.5 m

Site: Pearson Creek Bioassessment Study

Sample Reference ID:

Affiliation: ESP

Collect Date: 9/23/2014 4:30:00PM

UTM-Easting
482412ENorthing
4114585N

Composite; Sediment, Pearson Creek #1, located upstream of Farm Road 148 (Old Sunshine Street). Legal Description. N 1/2, Sec. 35, T29N, R21W

Test	Parameter	Result	Qualifier	Units	Method
6010B Metals-Total Recoverable	Manganese	500000		µg/kg	SW 846 6010B
6010B Metals-Total Recoverable	Nickel	14100		µg/kg	SW 846 6010B
6010B Metals-Total Recoverable	Selenium	<1000	ND	µg/kg	SW 846 6010B
6010B Metals-Total Recoverable	Thallium	1470	05	µg/kg	SW 846 6010B
6010B Metals-Total Recoverable	Zinc	284000		µg/kg	SW 846 6010B
BNAs	1,2,4-Trichlorobenzene	<154	09, ND	µg/kg	8270C
BNAs	1,2-Dichlorobenzene	<154	09, ND	µg/kg	8270C
BNAs	1,3-Dichlorobenzene	<154	09, ND	µg/kg	8270C
3NAs	1,4-Dichlorobenzene	<154	09, ND	µg/kg	8270C
3NAs	2,4,5-Trichlorophenol	<154	09, ND	µg/kg	8270C
3NAs	2,4,6-Trichlorophenol	<307	09, ND	µg/kg	8270C
3NAs	2,4-Dichlorophenol	<154	09, ND	µg/kg	8270C
3NAs	2,4-Dimethylphenol	<154	09, ND	µg/kg	8270C
3NAs	2,4-Dinitrophenol	<1540	09, ND, 29	µg/kg	8270C
3NAs	2,4-Dinitrotoluene	<614	09, ND, 29	µg/kg	8270C
3NAs	2,6-Dinitrotoluene	<154	09, ND, 29	µg/kg	8270C
3NAs	2-Chloronaphthalene	<307	09, ND	µg/kg	8270C
3NAs	2-Chlorophenol	<154	09, ND	µg/kg	8270C
3NAs	2-Methyl-4,6-dinitrophenol	<614	09, ND	µg/kg	8270C
3NAs	2-Methylnaphthalene	<154	09, ND	µg/kg	8270C
3NAs	2-Methylphenol	<154	09, ND	µg/kg	8270C
3NAs	2-Nitroaniline	<154	09, ND	µg/kg	8270C
3NAs	2-Nitrophenol	<154	09, ND	µg/kg	8270C
3NAs	3,3-Dichlorobenzidine	<154	09, ND, 29	µg/kg	8270C
3NAs	3-Nitroaniline	<154	09, ND	µg/kg	8270C
3NAs	4-Bromophenyl phenyl ether	<154	09, ND	µg/kg	8270C
3NAs	4-Chloro-3-methylphenol	<154	09, ND	µg/kg	8270C
3NAs	4-Chloroaniline	<154	09, ND, 29	µg/kg	8270C
3NAs	4-Chlorophenyl phenyl ether	<307	09, ND	µg/kg	8270C
3NAs	4-Methylphenol	<307	09, ND	µg/kg	8270C
3NAs	4-Nitroaniline	<154	09, ND	µg/kg	8270C
3NAs	4-Nitrophenol	<307	09, ND	µg/kg	8270C
3NAs	Acenaphthene	<154	09, ND	µg/kg	8270C
3NAs	Acenaphthylene	<154	09, ND	µg/kg	8270C
3NAs	Anthracene	<154	09, ND	µg/kg	8270C

Sample: AC36498



Customer #: 1411938

Facility ID:

County: Greene

Collector: MIKE IRWIN

Entry Point:

Sample Comment:

Precision

2.5 m

Site: Pearson Creek Bioassessment Study

Sample Reference ID:

Affiliation: ESP

Collect Date: 9/23/2014 4:30:00PM

UTM-Easting
482412ENorthing
4114585N

Composite; Sediment, Pearson Creek #1, located upstream of Farm Road 148 (Old Sunshine Street). Legal Description. N 1/2, Sec. 35, T29N, R21W

Test	Parameter	Result	Qualifier	Units	Method
BNAs	azobenzene	<154	09, ND	µg/kg	8270C
BNAs	Benzo(a)anthracene	<154	09, ND	µg/kg	8270C
BNAs	Benzo(a)pyrene	<154	09, ND	µg/kg	8270C
BNAs	Benzo(b)fluoranthene	<154	09, ND	µg/kg	8270C
BNAs	Benzo(ghi)perylene	<154	09, ND	µg/kg	8270C
BNAs	Benzo(k)fluoranthene	<154	09, ND	µg/kg	8270C
BNAs	Benzoic Acid	<307	09, ND, 29	µg/kg	8270C
BNAs	bis(2-Chloroethoxy)methane	<614	09, ND	µg/kg	8270C
BNAs	bis(2-Chloroethyl)ether	<154	09, ND	µg/kg	8270C
BNAs	bis(2-chloroisopropyl)ether	<154	09, ND	µg/kg	8270C
BNAs	bis(2-Ethylhexyl) phthalate	<307	09, ND	µg/kg	8270C
BNAs	Butyl benzyl phthalate	<307	09, ND	µg/kg	8270C
BNAs	Chrysene	<154	09, ND	µg/kg	8270C
BNAs	Dibenzo(a,h)anthracene	<154	09, ND	µg/kg	8270C
BNAs	Dibenzofuran	<154	09, ND	µg/kg	8270C
BNAs	Diethyl phthalate	<614	09, ND	µg/kg	8270C
BNAs	Dimethyl phthalate	<154	09, ND	µg/kg	8270C
BNAs	Di-n-butyl phthalate	<154	09, ND	µg/kg	8270C
BNAs	Di-n-octyl phthalate	<154	09, ND	µg/kg	8270C
BNAs	Fluoranthene	<154	09, ND	µg/kg	8270C
BNAs	Fluorene	<154	09, ND	µg/kg	8270C
BNAs	Hexachlorobenzene	<154	09, ND	µg/kg	8270C
BNAs	Hexachlorobutadiene	<154	09, ND	µg/kg	8270C
BNAs	Hexachlorocyclopentadiene	<307	09, ND	µg/kg	8270C
BNAs	Hexachloroethane	<154	09, ND	µg/kg	8270C
BNAs	Indeno(1,2,3-cd)pyrene	<154	09, ND	µg/kg	8270C
BNAs	Isophorone	<154	09, ND	µg/kg	8270C
BNAs	Naphthalene	<154	09, ND	µg/kg	8270C
BNAs	Nitrobenzene	<154	09, ND	µg/kg	8270C
BNAs	n-Nitroso-di-n-propylamine	<154	09, ND	µg/kg	8270C
BNAs	n-Nitrosodiphenylamine	<1540	09, ND	µg/kg	8270C
BNAs	Pentachlorophenol	<154	09, ND	µg/kg	8270C
BNAs	Phenanthrene	<154	09, ND	µg/kg	8270C
BNAs	Phenol	<154	09, ND	µg/kg	8270C
BNAs	Pyrene	<154	09, ND	µg/kg	8270C

Sample: AC36498**Customer #:** 1411938**UTM-Easting**
482412E**Northing**
4114585N**Facility ID:****County:** Greene**Collector:** MIKE IRWIN**Entry Point:****Sample Comment:****Precision**
2.5 m

Composite; Sediment, Pearson Creek #1, located upstream of Farm Road 148 (Old Sunshine Street). Legal Description. N 1/2, Sec. 35, T29N, R21W

Site: Pearson Creek Bioassessment Study**Sample Reference ID:****Affiliation:** ESP**Collect Date:** 9/23/2014 4:30:00PM

Test	Parameter	Result	Qualifier	Units	Method
Mercury-Total Recoverable	Mercury-Total Recoverable	75.1		µg/kg	SW 846 - 7471A
Percent Moisture	Percent Moisture	67.4		%	Infrared Drying

Sample: AC36499**Customer #:** 1411939**UTM-Easting**
182124E**Northing**
4115610N**Facility ID:****County:** Greene**Collector:** MIKE IRWIN**Entry Point:****Sample Comment:****Precision**
5.4 m

Composite; Sediment, Jones Spring Branch, located upstream of South Leaning Tree Lane. Legal Description: NW 1/4, Sec. 26, T29N, R21W.

Site: Pearson Creek Bioassessment Study**Sample Reference ID:****Affiliation:** ESP**Collect Date:** 9/23/2014 5:20:00PM

Test	Parameter	Result	Qualifier	Units	Method
010B Metals-Total Recoverable	Arsenic	1940	05	µg/kg	SW 846 6010B
010B Metals-Total Recoverable	Barium	119000		µg/kg	SW 846 6010B
010B Metals-Total Recoverable	Cadmium	2250		µg/kg	SW 846 6010B
010B Metals-Total Recoverable	Chromium	13400		µg/kg	SW 846 6010B
010B Metals-Total Recoverable	Cobalt	6080		µg/kg	SW 846 6010B
010B Metals-Total Recoverable	Copper	9990		µg/kg	SW 846 6010B
010B Metals-Total Recoverable	Lead	48600		µg/kg	SW 846 6010B
010B Metals-Total Recoverable	Manganese	335000		µg/kg	SW 846 6010B
010B Metals-Total Recoverable	Nickel	8120		µg/kg	SW 846 6010B
010B Metals-Total Recoverable	Selenium	<1000	ND	µg/kg	SW 846 6010B
010B Metals-Total Recoverable	Thallium	3370		µg/kg	SW 846 6010B
010B Metals-Total Recoverable	Zinc	216000		µg/kg	SW 846 6010B
NAs	1,2,4-Trichlorobenzene	<126	09, ND	µg/kg	8270C
NAs	1,2-Dichlorobenzene	<126	09, ND	µg/kg	8270C
NAs	1,3-Dichlorobenzene	<126	09, ND	µg/kg	8270C
NAs	1,4-Dichlorobenzene	<126	09, ND	µg/kg	8270C
NAs	2,4,5-Trichlorophenol	<126	09, ND	µg/kg	8270C
NAs	2,4,6-Trichlorophenol	<252	09, ND	µg/kg	8270C
NAs	2,4-Dichlorophenol	<126	09, ND	µg/kg	8270C
NAs	2,4-Dimethylphenol	<126	09, ND	µg/kg	8270C
NAs	2,4-Dinitrophenol	<1260	09, ND, 29	µg/kg	8270C
NAs	2,4-Dinitrotoluene	<504	09, ND, 29	µg/kg	8270C
NAs	2,6-Dinitrotoluene	<126	09, ND, 29	µg/kg	8270C
NAs	2-Chloronaphthalene	<252	09, ND	µg/kg	8270C

Sample: AC36499



Customer #: 1411939

Facility ID:
County: Greene

Collector: MIKE IRWIN

Site: Pearson Creek Bioassessment Study

Sample Reference ID:

Affiliation: ESP

Collect Date: 9/23/2014 5:20:00PM

Entry Point:

Sample Comment: Composite; Sediment, Jones Spring Branch, located upstream of South Leaning Tree Lane. Legal Description: NW 1/4, Sec. 26, T29N, R21W.

UTM-Easting
482124ENorthing
4115610NPrecision
5.4 m

Test	Parameter	Result	Qualifier	Units	Method
BNAs	2-Chlorophenol	<126	09, ND	µg/kg	8270C
BNAs	2-Methyl-4,6-dinitrophenol	<504	09, ND	µg/kg	8270C
BNAs	2-Methylnaphthalene	469	09	µg/kg	8270C
BNAs	2-Methylphenol	<126	09, ND	µg/kg	8270C
BNAs	2-Nitroaniline	<126	09, ND	µg/kg	8270C
BNAs	2-Nitrophenol	<126	09, ND	µg/kg	8270C
BNAs	3,3-Dichlorobenzidine	<126	09, ND, 29	µg/kg	8270C
BNAs	3-Nitroaniline	<126	09, ND	µg/kg	8270C
BNAs	4-Bromophenyl phenyl ether	<126	09, ND	µg/kg	8270C
BNAs	4-Chloro-3-methylphenol	<126	09, ND	µg/kg	8270C
BNAs	4-Chloroaniline	<126	09, ND, 29	µg/kg	8270C
BNAs	4-Chlorophenyl phenyl ether	<252	09, ND	µg/kg	8270C
BNAs	4-Methylphenol	<252	09, ND	µg/kg	8270C
BNAs	4-Nitroaniline	<126	09, ND	µg/kg	8270C
BNAs	4-Nitrophenol	<252	09, ND	µg/kg	8270C
BNAs	Acenaphthene	<126	09, ND	µg/kg	8270C
BNAs	Acenaphthylene	<126	09, ND	µg/kg	8270C
BNAs	Anthracene	<126	09, ND	µg/kg	8270C
BNAs	azobenzene	<126	09, ND	µg/kg	8270C
BNAs	Benzo(a)anthracene	<126	09, ND	µg/kg	8270C
BNAs	Benzo(a)pyrene	<126	09, ND	µg/kg	8270C
BNAs	Benzo(b)fluoranthene	<126	09, ND	µg/kg	8270C
BNAs	Benzo(ghi)perylene	<126	09, ND	µg/kg	8270C
BNAs	Benzo(k)fluoranthene	<126	09, ND	µg/kg	8270C
BNAs	Benzoic Acid	<252	09, ND, 29	µg/kg	8270C
BNAs	bis(2-Chloroethoxy)methane	<504	09, ND	µg/kg	8270C
BNAs	bis(2-Chloroethyl)ether	<126	09, ND	µg/kg	8270C
BNAs	bis(2-chloroisopropyl)ether	<126	09, ND	µg/kg	8270C
BNAs	bis(2-Ethylhexyl) phthalate	<252	09, ND	µg/kg	8270C
BNAs	Butyl benzyl phthalate	<252	09, ND	µg/kg	8270C
BNAs	Chrysene	<126	09, ND	µg/kg	8270C
BNAs	Dibenzo(a,h)anthracene	<126	09, ND	µg/kg	8270C
BNAs	Dibenzofuran	<126	09, ND	µg/kg	8270C
BNAs	Diethyl phthalate	<504	09, ND	µg/kg	8270C
BNAs	Dimethyl phthalate	<126	09, ND	µg/kg	8270C

Sample: AC36499



Customer #: 1411939

Facility ID:

County: Greene

Collector: MIKE IRWIN

Entry Point:

Sample Comment:

Precision

5.4 m

Site: Pearson Creek Bioassessment Study

Sample Reference ID:

Affiliation: ESP

Collect Date: 9/23/2014 5:20:00PM

UTM-Easting
482124ENorthing
4115610N

Composite; Sediment, Jones Spring Branch, located upstream of South Leaning Tree Lane. Legal Description: NW 1/4, Sec. 26, T29N, R21W.

Test	Parameter	Result	Qualifier	Units	Method
BNAs	Di-n-butyl phthalate	<126	09, ND	µg/kg	8270C
BNAs	Di-n-octyl phthalate	<126	09, ND	µg/kg	8270C
BNAs	Fluoranthene	<126	09, ND	µg/kg	8270C
BNAs	Fluorene	<126	09, ND	µg/kg	8270C
BNAs	Hexachlorobenzene	<126	09, ND	µg/kg	8270C
BNAs	Hexachlorobutadiene	<126	09, ND	µg/kg	8270C
BNAs	Hexachlorocyclopentadiene	<252	09, ND	µg/kg	8270C
BNAs	Hexachloroethane	<126	09, ND	µg/kg	8270C
BNAs	Indeno(1,2,3-cd)pyrene	<126	09, ND	µg/kg	8270C
BNAs	Isophorone	<126	09, ND	µg/kg	8270C
BNAs	Naphthalene	400	09	µg/kg	8270C
BNAs	Nitrobenzene	<126	09, ND	µg/kg	8270C
BNAs	n-Nitroso-di-n-propylamine	<126	09, ND	µg/kg	8270C
BNAs	n-Nitrosodiphenylamine	<1260	09, ND	µg/kg	8270C
BNAs	Pentachlorophenol	<126	09, ND	µg/kg	8270C
BNAs	Phenanthrene	298	09	µg/kg	8270C
BNAs	Phenol	<126	09, ND	µg/kg	8270C
BNAs	Pyrene	174	09, 05	µg/kg	8270C
Mercury-Total Recoverable	Mercury-Total Recoverable	31.1		µg/kg	SW 846 - 7471A
Percent Moisture	Percent Moisture	60.3		%	Infrared Drying

The analysis of this sample was performed in accordance with procedures approved or recognized by the U.S Environmental Protection Agency.

Qualifier Descriptions

01 Improper collection method
03 Exceeded holding time
05 Estimated value, detected below PQL
07 Estimated value, analyte outside calibration range
09 Sample was diluted during analysis
11 Estimated value, matrix interference
13 Estimated value, true result is >= reported value
15 No Result - Failed Quality Controls Requirements
17 Results in dry weight
19 Estimated value
21 No result - spectral interference
23 Contract Lab specific qualifier - see sample comments
25 No Result: Excessive Chlorination
27 Sample temperature outside acceptable range
29 Estimated value, QC data biased low
ND Not detected at reported value

02 Improper preservation
04 Analyzed by Contract Laboratory
06 Estimated value, QC data outside limits
08 Analyte present in blank at > 1/2 reported value
10 Laboratory error
12 Insufficient quantity
14 Estimated value, non-homogeneous sample
16 Not analyzed - related analyte not detected
18 Sample pH is outside the acceptable range
20 Not analyzed - Instrument failure
22 pH was performed at the Laboratory
24 No result - matrix interference
26 No Result: Excessive Dechlorination
28 Headspace (air bubbles) present in sample vial
30 Estimated value, QC data biased high

Chris Boldt, Laboratory Manager
Environmental Services Program
Division of Environmental Quality

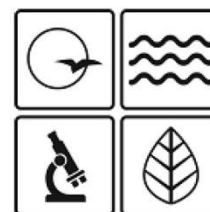


STATE OF MISSOURI
DEPARTMENT OF NATURAL RESOURCES
PO Box 176 Jefferson City MO 65102-0176

Environmental Services Program
RESULTS OF SAMPLE ANALYSES

LDPR/Job Code:
FEBIO

Program, Contact:
WPC Trish Rielly



Order ID:
150327007



Report Date:
4/22/2015

Trish Rielly
Water Pollution Control Branch

Sample: AC44893			Customer #: 151854		
			Site: Pearson Creek Bioassessment Study		
Collect Date: 3/25/2015 10:05:00 AM			Collector: CARL WAKEFIELD		
			County: Greene		
			Affiliation: ESP		
UTM Easting	Northing	Precision	Comments: Composite; Sediment, Pearson Creek #1, located downstream of Farm Road 148 (Old Sunshine Street). Legal Description: N 1/2, Sec. 35, T29N, R21W.		
482412E	4114585N	2.5 m			
Test	Parameter/Method	Result	Units	Qualifier(s)	
6010B Metals-Total Recoverable	Arsenic/SW 846 6010B	3290	µg/kg		
6010B Metals-Total Recoverable	Barium/SW 846 6010B	126000	µg/kg		
6010B Metals-Total Recoverable	Cadmium/SW 846 6010B	2820	µg/kg		
6010B Metals-Total Recoverable	Chromium/SW 846 6010B	21200	µg/kg		
6010B Metals-Total Recoverable	Cobalt/SW 846 6010B	12100	µg/kg		
6010B Metals-Total Recoverable	Copper/SW 846 6010B	14900	µg/kg		
6010B Metals-Total Recoverable	Lead/SW 846 6010B	49200	µg/kg		
6010B Metals-Total Recoverable	Manganese/SW 846 6010B	589000	µg/kg		
6010B Metals-Total Recoverable	Nickel/SW 846 6010B	15100	µg/kg		
6010B Metals-Total Recoverable	Selenium/SW 846 6010B	<1000	µg/kg	ND	
6010B Metals-Total Recoverable	Thallium/SW 846 6010B	1890	µg/kg	05	
6010B Metals-Total Recoverable	Zinc/SW 846 6010B	353000	µg/kg		
BNAs	1,2,4-Trichlorobenzene/8270C	<239	µg/kg	09, ND	
BNAs	1,2-Dichlorobenzene/8270C	<239	µg/kg	09, ND	
BNAs	1,3-Dichlorobenzene/8270C	<239	µg/kg	09, ND	
BNAs	1,4-Dichlorobenzene/8270C	<239	µg/kg	09, ND	
BNAs	2,4,5-Trichlorophenol/8270C	<239	µg/kg	09, ND	
BNAs	2,4,6-Trichlorophenol/8270C	<478	µg/kg	09, ND	
BNAs	2,4-Dichlorophenol/8270C	<239	µg/kg	09, ND	
BNAs	2,4-Dimethylphenol/8270C	<239	µg/kg	09, ND	
BNAs	2,4-Dinitrophenol/8270C	<2390	µg/kg	09, ND	
BNAs	2,4-Dinitrotoluene/8270C	<956	µg/kg	09, ND	
BNAs	2,6-Dinitrotoluene/8270C	<239	µg/kg	09, ND	
BNAs	2-Chloronaphthalene/8270C	<478	µg/kg	09, ND	
BNAs	2-Chlorophenol/8270C	<239	µg/kg	09, ND	
BNAs	2-Methyl-4,6-dinitrophenol/8270C	<956	µg/kg	09, ND	
BNAs	2-Methylnaphthalene/8270C	<1910	µg/kg	08, 09, ND	
BNAs	2-Methylphenol/8270C	<239	µg/kg	09, ND	
BNAs	2-Nitroaniline/8270C	<239	µg/kg	09, ND	
BNAs	2-Nitrophenol/8270C	<239	µg/kg	09, ND	
BNAs	3,3-Dichlorobenzidine/8270C	<239	µg/kg	09, ND	
BNAs	3-Nitroaniline/8270C	<239	µg/kg	09, ND	
BNAs	4-Bromophenyl phenyl ether/8270C	<239	µg/kg	09, ND	

Order ID: 150327007 (1/5)

Page 1 of 5

Sample: AC44893			Customer #: 151854		
			Site: Pearson Creek Bioassessment Study		County: Greene
Collect Date: 3/25/2015 10:05:00 AM			Collector: CARL WAKEFIELD		Affiliation: ESP
UTM Easting	Northing	Precision	Comments: Composite; Sediment, Pearson Creek #1, located downstream of Farm Road 148 (Old Sunshine Street). Legal Description: N 1/2, Sec. 35, T29N, R21W.		
482412E	4114585N	2.5 m			
BNAs		4-Chloro-3-methylphenol/8270C	<239	µg/kg	09, ND
BNAs		4-Chloroaniline/8270C	<239	µg/kg	09, ND
BNAs		4-Chlorophenyl phenyl ether/8270C	<478	µg/kg	09, ND
BNAs		4-Methylphenol/8270C	512	µg/kg	09, 05
BNAs		4-Nitroaniline/8270C	<239	µg/kg	09, ND
BNAs		4-Nitrophenol/8270C	<478	µg/kg	09, ND
BNAs		Acenaphthene/8270C	<239	µg/kg	09, ND
BNAs		Acenaphthylene/8270C	<239	µg/kg	09, ND
BNAs		Anthracene/8270C	<239	µg/kg	09, ND
BNAs		azobenzene/8270C	<239	µg/kg	09, ND
BNAs		Benzo(a)anthracene/8270C	<239	µg/kg	09, ND
BNAs		Benzo(a)pyrene/8270C	<239	µg/kg	09, ND
BNAs		Benzo(b)fluoranthene/8270C	<239	µg/kg	09, ND
BNAs		Benzo(ghi)perylene/8270C	<239	µg/kg	09, ND
BNAs		Benzo(k)fluoranthene/8270C	<239	µg/kg	09, ND
BNAs		Benzoic Acid/8270C	<478	µg/kg	09, ND
BNAs		bis(2-Chloroethoxy)methane/8270C	<956	µg/kg	09, ND
BNAs		bis(2-Chloroethyl)ether/8270C	<239	µg/kg	09, ND
BNAs		bis(2-chloroisopropyl)ether/8270C	<239	µg/kg	09, ND
BNAs		bis(2-Ethylhexyl) phthalate/8270C	<478	µg/kg	09, ND
BNAs		Butyl benzyl phthalate/8270C	<478	µg/kg	09, ND
BNAs		Chrysene/8270C	<239	µg/kg	09, ND
BNAs		Dibenzo(a,h)anthracene/8270C	<239	µg/kg	09, ND
BNAs		Dibenzofuran/8270C	<239	µg/kg	09, ND
BNAs		Diethyl phthalate/8270C	<956	µg/kg	09, ND
BNAs		Dimethyl phthalate/8270C	<239	µg/kg	09, ND
BNAs		Di-n-butyl phthalate/8270C	<239	µg/kg	09, ND
BNAs		Di-n-octyl phthalate/8270C	<239	µg/kg	09, ND
BNAs		Fluoranthene/8270C	<239	µg/kg	09, ND
BNAs		Fluorene/8270C	<239	µg/kg	09, ND
BNAs		Hexachlorobenzene/8270C	<239	µg/kg	09, ND
BNAs		Hexachlorobutadiene/8270C	<239	µg/kg	09, ND
BNAs		Hexachlorocyclopentadiene/8270C	<478	µg/kg	09, ND
BNAs		Hexachloroethane/8270C	<239	µg/kg	09, ND
BNAs		Indeno(1,2,3-cd)pyrene/8270C	<239	µg/kg	09, ND
BNAs		Isophorone/8270C	<239	µg/kg	09, ND
BNAs		Naphthalene/8270C	<1440	µg/kg	08, 09, ND
BNAs		Nitrobenzene/8270C	<239	µg/kg	09, ND
BNAs		n-Nitroso-di-n-propylamine/8270C	<239	µg/kg	09, ND
BNAs		n-Nitrosodiphenylamine/8270C	<2390	µg/kg	09, ND
BNAs		Pentachlorophenol/8270C	<239	µg/kg	09, ND
BNAs		Phenanthrene/8270C	<239	µg/kg	09, ND
BNAs		Phenol/8270C	<239	µg/kg	09, ND
BNAs		Pyrene/8270C	<239	µg/kg	09, ND
Percent Moisture		Percent Moisture/Infrared Drying	79.1	%	

Sample: AC44894		Customer #: 151853	
		Site: Pearson Creek Bioassessment Study	County: Greene
Collect Date: 3/25/2015 11:35:00 AM		Collector: CARL WAKEFIELD	Affiliation: ESP
UTM Easting	Northing	Precision	Comments: Composite; Sediment, Pearson Creek #3, located upstream of Farm Road 136 (Cherry Street). Legal Description: NW 1/4, Sec. 23, T29N, R21W.
481938E	4117438N	3.2 m	
Test	Parameter/Method	Result	Units
6010B Metals-Total Recoverable	Arsenic/SW 846 6010B	3280	µg/kg
6010B Metals-Total Recoverable	Barium/SW 846 6010B	110000	µg/kg
6010B Metals-Total Recoverable	Cadmium/SW 846 6010B	336	µg/kg
6010B Metals-Total Recoverable	Chromium/SW 846 6010B	24300	µg/kg
6010B Metals-Total Recoverable	Cobalt/SW 846 6010B	11600	µg/kg
6010B Metals-Total Recoverable	Copper/SW 846 6010B	8590	µg/kg
6010B Metals-Total Recoverable	Lead/SW 846 6010B	16200	µg/kg
6010B Metals-Total Recoverable	Manganese/SW 846 6010B	479000	µg/kg
6010B Metals-Total Recoverable	Nickel/SW 846 6010B	14500	µg/kg
6010B Metals-Total Recoverable	Selenium/SW 846 6010B	<1000	µg/kg
6010B Metals-Total Recoverable	Thallium/SW 846 6010B	1190	µg/kg
6010B Metals-Total Recoverable	Zinc/SW 846 6010B	64200	µg/kg
BNAs	1,2,4-Trichlorobenzene/8270C	<137	µg/kg
BNAs	1,2-Dichlorobenzene/8270C	<137	µg/kg
BNAs	1,3-Dichlorobenzene/8270C	<137	µg/kg
BNAs	1,4-Dichlorobenzene/8270C	<137	µg/kg
BNAs	2,4,5-Trichlorophenol/8270C	<137	µg/kg
BNAs	2,4,6-Trichlorophenol/8270C	<274	µg/kg
BNAs	2,4-Dichlorophenol/8270C	<137	µg/kg
BNAs	2,4-Dimethylphenol/8270C	<137	µg/kg
BNAs	2,4-Dinitrophenol/8270C	<1370	µg/kg
BNAs	2,4-Dinitrotoluene/8270C	<548	µg/kg
BNAs	2,6-Dinitrotoluene/8270C	<137	µg/kg
BNAs	2-Chloronaphthalene/8270C	<274	µg/kg
BNAs	2-Chlorophenol/8270C	<137	µg/kg
BNAs	2-Methyl-4,6-dinitrophenol/8270C	<548	µg/kg
BNAs	2-Methylnaphthalene/8270C	<1100	µg/kg
BNAs	2-Methylphenol/8270C	<137	µg/kg
BNAs	2-Nitroaniline/8270C	<137	µg/kg
BNAs	2-Nitrophenol/8270C	<137	µg/kg
BNAs	3,3-Dichlorobenzidine/8270C	<137	µg/kg
BNAs	3-Nitroaniline/8270C	<137	µg/kg
BNAs	4-Bromophenyl phenyl ether/8270C	<137	µg/kg
BNAs	4-Chloro-3-methylphenol/8270C	<137	µg/kg
BNAs	4-Chloroaniline/8270C	<137	µg/kg
BNAs	4-Chlorophenyl phenyl ether/8270C	<274	µg/kg
BNAs	4-Methylphenol/8270C	<274	µg/kg
BNAs	4-Nitroaniline/8270C	<137	µg/kg
BNAs	4-Nitrophenol/8270C	<274	µg/kg
BNAs	Acenaphthene/8270C	<137	µg/kg
BNAs	Acenaphthylene/8270C	<137	µg/kg
BNAs	Anthracene/8270C	<137	µg/kg
BNAs	azobenzene/8270C	<137	µg/kg
BNAs	Benzo(a)anthracene/8270C	<137	µg/kg
BNAs	Benzo(a)pyrene/8270C	<137	µg/kg
BNAs	Benzo(b)fluoranthene/8270C	<137	µg/kg
BNAs	Benzo(ghi)perylene/8270C	<137	µg/kg
BNAs	Benzo(k)fluoranthene/8270C	<137	µg/kg
BNAs	Benzoic Acid/8270C	<274	µg/kg
BNAs	bis(2-Chloroethoxy)methane/8270C	<548	µg/kg
BNAs	bis(2-Chloroethyl)ether/8270C	<137	µg/kg

Sample: AC44894			Customer #: 151853		
			Site: Pearson Creek Bioassessment Study		County: Greene
Collect Date: 3/25/2015 11:35:00 AM			Collector: CARL WAKEFIELD		Affiliation: ESP
UTM Easting	Northing	Precision	Comments: Composite; Sediment, Pearson Creek #3, located upstream of Farm Road 136 (Cherry Street). Legal Description: NW 1/4, Sec. 23, T29N, R21W.		
481938E	4117438N	3.2 m			
BNAs		bis(2-chloroisopropyl)ether/8270C	<137	µg/kg	09, ND
BNAs		bis(2-Ethylhexyl) phthalate/8270C	<274	µg/kg	09, ND
BNAs		Butyl benzyl phthalate/8270C	<274	µg/kg	09, ND
BNAs		Chrysene/8270C	<137	µg/kg	09, ND
BNAs		Dibenzo(a,h)anthracene/8270C	<137	µg/kg	09, ND
BNAs		Dibenzofuran/8270C	<137	µg/kg	09, ND
BNAs		Diethyl phthalate/8270C	<548	µg/kg	09, ND
BNAs		Dimethyl phthalate/8270C	<137	µg/kg	09, ND
BNAs		Di-n-butyl phthalate/8270C	<137	µg/kg	09, ND
BNAs		Di-n-octyl phthalate/8270C	<137	µg/kg	09, ND
BNAs		Fluoranthene/8270C	<137	µg/kg	09, ND
BNAs		Fluorene/8270C	<137	µg/kg	09, ND
BNAs		Hexachlorobenzene/8270C	<137	µg/kg	09, ND
BNAs		Hexachlorobutadiene/8270C	<137	µg/kg	09, ND
BNAs		Hexachlorocyclopentadiene/8270C	<274	µg/kg	09, ND
BNAs		Hexachloroethane/8270C	<137	µg/kg	09, ND
BNAs		Indeno(1,2,3-cd)pyrene/8270C	<137	µg/kg	09, ND
BNAs		Isophorone/8270C	<137	µg/kg	09, ND
BNAs		Naphthalene/8270C	<822	µg/kg	08, 09, ND
BNAs		Nitrobenzene/8270C	<137	µg/kg	09, ND
BNAs		n-Nitroso-di-n-propylamine/8270C	<137	µg/kg	09, ND
BNAs		n-Nitrosodiphenylamine/8270C	<1370	µg/kg	09, ND
BNAs		Pentachlorophenol/8270C	<137	µg/kg	09, ND
BNAs		Phenanthrene/8270C	<137	µg/kg	09, ND
BNAs		Phenol/8270C	<137	µg/kg	09, ND
BNAs		Pyrene/8270C	<137	µg/kg	09, ND
Percent Moisture		Percent Moisture/Infrared Drying	63.5	%	
Sample: AC44895			Customer #: 151852		
			Site: Pearson Creek Bioassessment Study		County: Greene
Collect Date: 3/25/2015 12:45:00 PM			Collector: CARL WAKEFIELD		Affiliation: ESP
UTM Easting	Northing	Precision	Comments: Composite; Sediment, Pearson Creek #4, located downstream of Highway YY. Legal Description: NE 1/4, Sec. 13, T29N, R21W. BNA test was cancelled due to instrument failure.		
484815E	4119533N	5.6 m			
Test		Parameter/Method	Result	Units	Qualifier(s)
6010B Metals-Total Recoverable		Arsenic/SW 846 6010B	2350	µg/kg	05
6010B Metals-Total Recoverable		Barium/SW 846 6010B	165000	µg/kg	
6010B Metals-Total Recoverable		Cadmium/SW 846 6010B	883	µg/kg	
6010B Metals-Total Recoverable		Chromium/SW 846 6010B	17500	µg/kg	
6010B Metals-Total Recoverable		Cobalt/SW 846 6010B	10700	µg/kg	
6010B Metals-Total Recoverable		Copper/SW 846 6010B	10200	µg/kg	
6010B Metals-Total Recoverable		Lead/SW 846 6010B	17000	µg/kg	
6010B Metals-Total Recoverable		Manganese/SW 846 6010B	1180000	µg/kg	
6010B Metals-Total Recoverable		Nickel/SW 846 6010B	13400	µg/kg	
6010B Metals-Total Recoverable		Selenium/SW 846 6010B	1300	µg/kg	05
6010B Metals-Total Recoverable		Thallium/SW 846 6010B	2830	µg/kg	
6010B Metals-Total Recoverable		Zinc/SW 846 6010B	126000	µg/kg	
Percent Moisture		Percent Moisture/Infrared Drying	93.9	%	

Sample: AC44896		Customer #: 151851	
		Site: Pearson Creek Bioassessment Study	County: Greene
Collect Date: 3/25/2015 2:10:00 PM		Collector: CARL WAKEFIELD	Affiliation: ESP
UTM Easting	Northing	Precision	Comments: Composite; Sediment, Jones Spring Branch, located near Farm Road 144. Legal Description: NW 1/4, Sec. 26, T29N, R21W. BNA test was cancelled due to instrument failure.
482079E	4115763N	6.9 m	
Test	Parameter/Method	Result	Units Qualifier(s)
6010B Metals-Total Recoverable	Arsenic/SW 846 6010B	1480	µg/kg 05
6010B Metals-Total Recoverable	Barium/SW 846 6010B	87400	µg/kg
6010B Metals-Total Recoverable	Cadmium/SW 846 6010B	3830	µg/kg
6010B Metals-Total Recoverable	Chromium/SW 846 6010B	14600	µg/kg
6010B Metals-Total Recoverable	Cobalt/SW 846 6010B	7920	µg/kg
6010B Metals-Total Recoverable	Copper/SW 846 6010B	9980	µg/kg
6010B Metals-Total Recoverable	Lead/SW 846 6010B	88300	µg/kg
6010B Metals-Total Recoverable	Manganese/SW 846 6010B	504000	µg/kg
6010B Metals-Total Recoverable	Nickel/SW 846 6010B	9330	µg/kg
6010B Metals-Total Recoverable	Selenium/SW 846 6010B	<1000	µg/kg ND
6010B Metals-Total Recoverable	Thallium/SW 846 6010B	2560	µg/kg
6010B Metals-Total Recoverable	Zinc/SW 846 6010B	391000	µg/kg
Percent Moisture	Percent Moisture/Infrared Drying	66.9	%

The analysis of this sample was performed in accordance with procedures approved or recognized by the U. S. Environmental Protection Agency.

Chris Boldt

Chris Boldt, Laboratory Manager
Environmental Services Program
Division of Environmental Quality

Data Qualifier(s)			
05	Estimated value, detected below PQL	08	Analyte present in blank at > ½ reported value
09	Sample was diluted during analysis	ND	Not detected at reported value

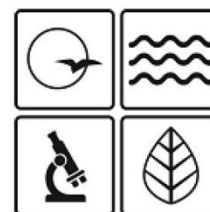


STATE OF MISSOURI
DEPARTMENT OF NATURAL RESOURCES
PO Box 176 Jefferson City MO 65102-0176

Environmental Services Program
RESULTS OF SAMPLE ANALYSES

LDPR/Job Code:
FEBIO

Program, Contact:
WPC Trish Rielly



Order ID:
150327012



Report Date:
5/4/2015

Trish Rielly
Water Pollution Control Branch

Sample: AC44907		Customer #: 151841	
		Site: Pearson Creek Bioassessment Study	County: Greene
Collect Date: 3/25/2015 10:25:00 AM	Collector: MIKE IRWIN	Affiliation: ESP	
UTM Easting	Northing	Precision	Comments: Grab; Water, Pearson Creek #1, located downstream of Farm Road 148 (Old Sunshine Street). Legal Description: N 1/2, Sec. 35, T29N, R21W
482412E	4114585N	2.5 m	
Test	Parameter/Method	Result	Units Qualifier(s)
200.7 Metals-Dissolved	Calcium/EPA 200.7	85.2	mg/L
200.7 Metals-Dissolved	Magnesium/EPA 200.7	4.64	mg/L
200.8 Metals-Dissolved	Arsenic/EPA 200.8	<0.50	µg/L ND, 30
200.8 Metals-Dissolved	Barium/EPA 200.8	63.7	µg/L
200.8 Metals-Dissolved	Cadmium/EPA 200.8	<0.10	µg/L ND
200.8 Metals-Dissolved	Chromium/EPA 200.8	2.83	µg/L
200.8 Metals-Dissolved	Cobalt/EPA 200.8	<1	µg/L ND
200.8 Metals-Dissolved	Copper/EPA 200.8	<0.50	µg/L ND
200.8 Metals-Dissolved	Lead/EPA 200.8	<0.50	µg/L ND
200.8 Metals-Dissolved	Manganese/EPA 200.8	4.65	µg/L
200.8 Metals-Dissolved	Mercury/EPA 200.8	0.13	µg/L 05
200.8 Metals-Dissolved	Nickel/EPA 200.8	0.64	µg/L 05
200.8 Metals-Dissolved	Selenium/EPA 200.8	<1	µg/L ND, 30
200.8 Metals-Dissolved	Thallium/EPA 200.8	<0.50	µg/L ND
200.8 Metals-Dissolved	Zinc/EPA 200.8	4.44	µg/L
Ammonia as N	Ammonia as N/L 10-107-06-1-J	<0.03	mg/L ND
Chloride	Chloride/L 10-117-07-1-A	23.9	mg/L 250
Field Dissolved Oxygen	Field Dissolved Oxygen/SM 4500-O-G	10.99	mg/L
Field pH	Field pH/EPA 150.1	7.9	pH Units 19
Field Specific Conductivity	Field Specific Conductivity/SM 2510	456 uS/cm	
Field Temperature	Field Temperature/EPA 170.1	13.0 C	
Field Turbidity	Field Turbidity/EPA 180.1	2.50	NTU
Flow	Flow/Field Dependent	26.55 cfs	
Hardness as CaCO3 Dissolved-N	Hardness as CaCO3 Dissolved-N/SM 2340-B	232	mg/L
Nitrate + Nitrite as N	Nitrate + Nitrite as N/L 10-107-04-1-C	2.37	mg/L 09
Sulfate	Sulfate/L 10-116-10-2-A	11.4	mg/L 250
Total Nitrogen	Total Nitrogen/USGS I-2650-03	2.35	mg/L
Total Phosphorus	Total Phosphorus/USGS I-2650-03	<0.01	mg/L ND
Total Suspended Solids (TSS) / NFR	Total Suspended Solids (TSS) / NFR/SM 2540-D	<5	mg/L ND

Order ID: 150327012 (1/4)

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Sample: AC44908		Customer #: 151842	
		Site: Pearson Creek Bioassessment Study	County: Greene
Collect Date: 3/25/2015 11:35:00 AM		Collector: MIKE IRWIN	Affiliation: ESP
UTM Easting	Northing	Precision	Comments: Grab; Water, Pearson Creek #3, located upstream of Farm Road 136 (Cherry Street). Legal Description: NW 1/4, Sec. 23, T29N, R21W
481938E	4117438N	3.2 m	
Test	Parameter/Method	Result	Units Qualifier(s)
200.7 Metals-Dissolved	Calcium/EPA 200.7	72.1	mg/L
200.7 Metals-Dissolved	Magnesium/EPA 200.7	5.43	mg/L
200.8 Metals-Dissolved	Arsenic/EPA 200.8	<0.50	µg/L ND
200.8 Metals-Dissolved	Barium/EPA 200.8	55.9	µg/L
200.8 Metals-Dissolved	Cadmium/EPA 200.8	<0.10	µg/L ND
200.8 Metals-Dissolved	Chromium/EPA 200.8	2.56	µg/L
200.8 Metals-Dissolved	Cobalt/EPA 200.8	<1	µg/L ND
200.8 Metals-Dissolved	Copper/EPA 200.8	<0.50	µg/L ND
200.8 Metals-Dissolved	Lead/EPA 200.8	<0.50	µg/L ND
200.8 Metals-Dissolved	Manganese/EPA 200.8	4.81	µg/L
200.8 Metals-Dissolved	Mercury/EPA 200.8	<0.10	µg/L ND
200.8 Metals-Dissolved	Nickel/EPA 200.8	0.52	µg/L 05
200.8 Metals-Dissolved	Selenium/EPA 200.8	<1	µg/L ND
200.8 Metals-Dissolved	Thallium/EPA 200.8	<0.50	µg/L ND
200.8 Metals-Dissolved	Zinc/EPA 200.8	3.35	µg/L
Ammonia as N	Ammonia as N/L 10-107-06-1-J	<0.03	mg/L ND
Chloride	Chloride/L 10-117-07-1-A	14.4	mg/L 250
Field Dissolved Oxygen	Field Dissolved Oxygen/SM 4500-O-G	12.18	mg/L
Field pH	Field pH/EPA 150.1	7.9	pH Units 19
Field Specific Conductivity	Field Specific Conductivity/SM 2510	382 µS/cm	
Field Temperature	Field Temperature/EPA 170.1	12.7 C	
Field Turbidity	Field Turbidity/EPA 180.1	1.85	NTU
Flow	Flow/Field Dependent	14.42 cfs	
Hardness as CaCO3 Dissolved-N	Hardness as CaCO3 Dissolved-N/SM 2340-B	202	mg/L
Nitrate + Nitrite as N	Nitrate + Nitrite as N/L 10-107-04-1-C	1.72	mg/L
Sulfate	Sulfate/L 10-116-10-2-A	10.3	mg/L 250
Total Nitrogen	Total Nitrogen/USGS I-2650-03	1.73	mg/L
Total Phosphorus	Total Phosphorus/USGS I-2650-03	<0.01	mg/L ND
Total Suspended Solids (TSS) / NFR	Total Suspended Solids (TSS) / NFR/SM 2540-D	<5	mg/L ND

Sample: AC44909		Customer #: 151843	
		Site: Pearson Creek Bioassessment Study	County: Greene
Collect Date: 3/25/2015 12:45:00 PM		Collector: MIKE IRWIN	Affiliation: ESP
UTM Easting	Northing	Precision	Comments: Grab; Water, Pearson Creek #4, located downstream of Hwy. YY. Legal Description: NE 1/4, Sec. 13, T29N, R21W
484815E	4119533N	5.6 m	
Test	Parameter/Method	Result	Units Qualifier(s)
200.7 Metals-Dissolved	Calcium/EPA 200.7	71.2	mg/L
200.7 Metals-Dissolved	Magnesium/EPA 200.7	5.35	mg/L
200.8 Metals-Dissolved	Arsenic/EPA 200.8	<0.50	µg/L ND
200.8 Metals-Dissolved	Barium/EPA 200.8	52.8	µg/L
200.8 Metals-Dissolved	Cadmium/EPA 200.8	<0.10	µg/L ND
200.8 Metals-Dissolved	Chromium/EPA 200.8	2.01	µg/L
200.8 Metals-Dissolved	Cobalt/EPA 200.8	<1	µg/L ND
200.8 Metals-Dissolved	Copper/EPA 200.8	<0.50	µg/L ND
200.8 Metals-Dissolved	Lead/EPA 200.8	<0.50	µg/L ND
200.8 Metals-Dissolved	Manganese/EPA 200.8	7.65	µg/L
200.8 Metals-Dissolved	Mercury/EPA 200.8	<0.10	µg/L ND
200.8 Metals-Dissolved	Nickel/EPA 200.8	0.50	µg/L 05
200.8 Metals-Dissolved	Selenium/EPA 200.8	<1	µg/L ND
200.8 Metals-Dissolved	Thallium/EPA 200.8	<0.50	µg/L ND
200.8 Metals-Dissolved	Zinc/EPA 200.8	2.85	µg/L
Ammonia as N	Ammonia as N/L 10-107-06-1-J	<0.03	mg/L ND
Chloride	Chloride/L 10-117-07-1-A	15.7	mg/L 250
Field Dissolved Oxygen	Field Dissolved Oxygen/SM 4500-O-G	11.75	mg/L
Field pH	Field pH/EPA 150.1	8	pH Units 19
Field Specific Conductivity	Field Specific Conductivity/SM 2510	378 µS/cm	
Field Temperature	Field Temperature/EPA 170.1	13.8 C	
Field Turbidity	Field Turbidity/EPA 180.1	1.43	NTU
Flow	Flow/Field Dependent	12.15 cfs	
Hardness as CaCO3 Dissolved-N	Hardness as CaCO3 Dissolved-N/SM 2340-B	200	mg/L
Nitrate + Nitrite as N	Nitrate + Nitrite as N/L 10-107-04-1-C	1.78	mg/L
Sulfate	Sulfate/L 10-116-10-2-A	9.58	mg/L 250
Total Nitrogen	Total Nitrogen/USGS I-2650-03	1.78	mg/L
Total Phosphorus	Total Phosphorus/USGS I-2650-03	<0.01	mg/L ND
Total Suspended Solids (TSS) / NFR	Total Suspended Solids (TSS) / NFR/SM 2540-D	<5	mg/L ND

Sample: AC44910		Customer #: 151844	
		Site: Pearson Creek Bioassessment Study	County: Greene
Collect Date: 3/25/2015 2:10:00 PM		Collector: MIKE IRWIN	Affiliation: ESP
UTM Easting	Northing	Precision	Comments: Grab; Water, Jones Spring Branch, located near Farm Road 144. Legal Description: NW 1/4, Sec. 26, T29N, R21W
482079E	4115763N	6.9 m	
Test	Parameter/Method	Result	Units
200.7 Metals-Dissolved	Calcium/EPA 200.7	108	mg/L
200.7 Metals-Dissolved	Magnesium/EPA 200.7	3.17	mg/L
200.8 Metals-Dissolved	Arsenic/EPA 200.8	<0.50	µg/L ND
200.8 Metals-Dissolved	Barium/EPA 200.8	79.1	µg/L
200.8 Metals-Dissolved	Cadmium/EPA 200.8	<0.10	µg/L ND
200.8 Metals-Dissolved	Chromium/EPA 200.8	2.51	µg/L
200.8 Metals-Dissolved	Cobalt/EPA 200.8	<1	µg/L ND
200.8 Metals-Dissolved	Copper/EPA 200.8	0.59	µg/L 05
200.8 Metals-Dissolved	Lead/EPA 200.8	<0.50	µg/L ND
200.8 Metals-Dissolved	Manganese/EPA 200.8	11.5	µg/L
200.8 Metals-Dissolved	Mercury/EPA 200.8	<0.10	µg/L ND
200.8 Metals-Dissolved	Nickel/EPA 200.8	0.76	µg/L 05
200.8 Metals-Dissolved	Selenium/EPA 200.8	<1	µg/L ND
200.8 Metals-Dissolved	Thallium/EPA 200.8	<0.50	µg/L ND
200.8 Metals-Dissolved	Zinc/EPA 200.8	3.00	µg/L
Ammonia as N	Ammonia as N/L 10-107-06-1-J	<0.03	mg/L ND
Chloride	Chloride/L 10-117-07-1-A	62.0	mg/L 250
Field Dissolved Oxygen	Field Dissolved Oxygen/SM 4500-O-G	10.58	mg/L
Field pH	Field pH/EPA 150.1	7.9	pH Units 19
Field Specific Conductivity	Field Specific Conductivity/SM 2510	607 uS/cm	
Field Temperature	Field Temperature/EPA 170.1	15.3 C	
Field Turbidity	Field Turbidity/EPA 180.1	1.87	NTU
Flow	Flow/Field Dependent	4.00 cfs	
Hardness as CaCO3 Dissolved-N	Hardness as CaCO3 Dissolved-N/SM 2340-B	283	mg/L
Nitrate + Nitrite as N	Nitrate + Nitrite as N/L 10-107-04-1-C	2.84	mg/L 09
Sulfate	Sulfate/L 10-116-10-2-A	14.9	mg/L 250
Total Nitrogen	Total Nitrogen/USGS I-2650-03	2.78	mg/L
Total Phosphorus	Total Phosphorus/USGS I-2650-03	<0.01	mg/L ND
Total Suspended Solids (TSS) / NFR	Total Suspended Solids (TSS) / NFR/SM 2540-D	<5	mg/L ND

The analysis of this sample was performed in accordance with procedures approved or recognized by the U. S. Environmental Protection Agency.

Data Qualifier(s)			
05	Estimated value, detected below PQL	09	Sample was diluted during analysis
19	Estimated value	30	Estimated value, QC data biased high
ND	Not detected at reported value		

Chris Boldt, Laboratory Manager
Environmental Services Program
Division of Environmental Quality